

# NUCLEAR SCIENCE ABSTRACTS

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# NUCLEAR SCIENCE ABSTRACTS

Vol. 8

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No. 20

## GENERAL

### ATOMIC POWER

6044

THE OUTLOOK FOR INDUSTRIAL NUCLEAR POWER—1954. Alvin M. Weinberg (Oak Ridge National Lab., Tenn.). *Am. Scientist* 42, 461-70(1954) July.

### RESEARCH PROGRAMS

6045

A NUCLEAR JOURNEY THROUGH EUROPE. Alvin M. Weinberg. *Bull. Atomic Scientists* 10, 215-17(1954) June.

Impressions are presented of the status of the nuclear energy program in European countries gained during the Oslo Heavy Water Reactor Conference and visits to atomic energy laboratories in European countries. (C.H.)

6046

SCIENTIFIC RESEARCH IN THE UNITED KINGDOM-1952-53 I. THE APPLICATION OF RADIO-ISOTOPES. *Atomics* 5, 234-5(1954) Aug.

## BIOLOGY AND MEDICINE

### AEROSOLS

6047

Air Cleaning Lab., Harvard Univ. School of Public Health LABORATORY PERFORMANCE OF FABRIC DUST AND FUME COLLECTORS. Charles E. Billings, Melvin W. First, Richard Dennie, and Leslie Silverman. Aug. 31, 1954. 129p. Contract AT(30-1)-841. (NYO-1590)

Three representative commercial fabric dust collectors have been investigated to determine fundamental operating characteristics. These characteristics include resistance, collection efficiency, type of fabric, effectiveness of cleaning mechanism as related to aerosol characteristics, dust loading, and filtering velocity. One collector tested employed intermittent cleaning of sateen weave cotton filter bags by mechanical shaking without air flow. Another collector utilized continuous cleaning of a wool felt filter bag by means of a high-velocity jet of reverse flow air blown through the media from a traversing ring on the clean air side. No interruption of primary air flow occurred during cleaning. The third collector tested contained four compartments with provision for automatic cleaning by rapping each compartment separately while back flow air was admitted to the bags (sateen weave cotton). During rapping of bags in one compartment primary air flow was maintained by the other three. Comparison of performance of these three collectors showed that the intermittently cleaned unit had high collection

efficiencies with low resistance and filtering velocity but had large variations in resistance with heavy dust loadings; the reverse-jet unit had moderately high collection efficiencies, was capable of high filtering velocities, and its resistance was relatively independent of dust loading; the periodically cleaned collector had the lowest collection efficiencies and the highest operating resistances at moderate filtering velocities. (auth)

### RADIATION EFFECTS

6048

Quartermaster Food and Container Inst., Chicago IONIZING RADIATIONS. THEIR PRODUCTION, EFFECTS, AND UTILIZATION (WITH SPECIAL REFERENCE TO FOOD AND PACKAGING TECHNOLOGY). BIBLIOGRAPHIC SERIES NO. 4, [PART 2]. June 1954. 341p. (NP-5297)

Over 2000 references are presented covering theoretical and practical aspects of the use of ionizing radiations for the sterilization of food. (J.S.R.)

6049

Quartermaster Food and Container Inst., Chicago IONIZING RADIATIONS. THEIR PRODUCTION, EFFECTS, AND UTILIZATION (WITH SPECIAL REFERENCE TO FOOD AND PACKAGING TECHNOLOGY). SUBJECT INDEX. BIBLIOGRAPHIC SERIES NO. 4, [PART 3]. June 1954. 276p. (NP-5298)

The subject index to over 4500 references covering theoretical and practical aspects of the use of ionizing radiations for the sterilization of food is presented. (J.S.R.)

6050

Massachusetts Inst. of Tech. BACTERICIDAL EFFECTS OF IONIZING RADIATIONS ON *E. COLI*, *S. THERMOACIDURANS*, AND *CL. SPOROGENES* AS INFLUENCED BY DIFFERENT CONDITIONS OF ATMOSPHERE, MEDIUM, AND PHYSICAL STATE IN WHICH SAMPLES ARE IRRADIATED. FINAL REPORT FOR THE PERIOD JANUARY 1, 1954 THROUGH JUNE 30, 1954. Bernard E. Proctor and Samuel A. Goldblith. June 30, 1954. 44p. Contract AT(30-1)-1164. (NYO-3344).

Data are presented from studies on the effects of atmosphere, medium, and the frozen state on the radioresistance of *E. Coli* and on the radioresistance of spores of *B. thermoacidurans* and *Cl. sporogenes*. (C.H.)

6051

Radiological Research Lab., Columbia Univ. ANNUAL REPORT ON RESEARCH PROJECT. G. Failla and H. H. Rossi. Apr. 1, 1954. 149p. Contract AT-30-1-GEN-70. (NYO-4582)

More reliable tissue equivalent ionization chambers have been constructed for the dosimetry of fast and slow neutrons. A comparative study of the mass stopping power of water and water vapor for alpha particles has been carried out. No difference was detected within the limits of experimental error. Measurements of the surface dose from a

$P^{32}$ -activated bakelite plate by means of an extrapolation chamber were compared and were in excellent agreement with results from four other laboratories. Work has continued on the measurement of beta-ray isotopes in absolute terms. Two methods which have been used are discussed, and a third method involving scintillation crystals is described. Values, relative to air, of the average energy lost by  $S^{35}$  beta rays per ion pair produced in six different gases are given. A microcalorimetric method for the determination of the average energy per disintegration for low-energy beta-ray isotopes is described. Some measurements made with wall-less ionization chambers for the determination of the integral dose (in ergs) to cells of various radii containing radioactive material are described. Preliminary values of the dose to cells with radii up to 150 microns from  $P^{32}$  concentrated at their centers are given. Depth-dose determinations have been made for uniform plant distributions of  $S^{35}$ ,  $P^{32}$ , and  $I^{131}$  using plastic filters. Studies in protection, tissue hydration, and fertility changes following total-body x irradiation of animals are described. Work in progress includes investigations on protection (of adult and fetus) against acute and chronic exposures to x rays, fetal sensitivity (eyes and gonads), reduction of tissue intolerance of mice to human tumors by prior x irradiation, and the relation of the three phases of estrus to radiosensitivity. Studies on radiation-induced cataracts in rabbits have continued. Results show that alpha particles and deuterons are much more effective than x rays in producing cataracts. Various agents injected systemically into rats had no effect on the results of x irradiation of the lens. In conjunction with this study, the effect of x radiation on the metabolism of ribose liberated from nucleotides in rabbit lenses is being investigated. The mechanism whereby an anemia is produced in rabbits by irradiation of the exteriorized spleen alone is under investigation. Hematological data on rabbits with spleen only irradiation, with total-body irradiation, with splenectomy and total body irradiation, and on control groups are compared. A method is suggested for the interpretation of the ultraviolet survival curves of  $T_1$  bacteriophage on a hypothesis of UV-induced changes of state of the phage, superimposed upon initial physical and chemical variations of state already present. This method leads to a model which fits the data for four of the irradiation conditions. (For preceding period see NYO-4523.) (auth)

#### 6052

Atomic Energy Project, Univ. of Calif., Los Angeles  
GLUCOSE TRANSPORT ACROSS THE WALL OF THE  
INTESTINE OF IRRADIATED AND NON-IRRADIATED  
RATS. Lawrence E. Detrick, Harvey C. Upham, Dorothy  
Highby, Virginia Debley, and Thomas J. Haley. Sept. 3,  
1954. 17p. Contract AT-04-1-GEN-12. (UCLA-302)

Acute whole-body x irradiation inhibited glucose absorption in the perfused, surviving intestinal segment of the rat. The period, 3 to 6 days, showed the greatest degree of inhibition of absorption. An early period of dehydration followed by a later period of hydration of the perfused intestine was observed. An attempt was made to correlate the histological findings with the changes in the rate of glucose absorption in the intestine after whole-body irradiation, and it was found that the microscopic evidence of morphological recovery after the injury gave no guarantee of functional recovery. (auth)

#### 6053

Radiological Lab., Univ. of Calif., San Francisco. School of Medicine

PROGRESS REPORT [FOR] JANUARY 1, 1954-JULY 31, 1954. Aug. 27, 1954. 25p. Contract AT-11-1-GEN-10. (UCSF-9)

Physics. Modifications in the 70-Mev synchrotron to insure a uniform x-ray field for all normal operating conditions and insure ease of maintenance are discussed. Biology. Studies were completed relating to the relative biological effectiveness (RBE) of 22.5-Mv x rays in the yeast test, the nature of the reaction of the mouse thymus to x rays and its suitability for use in RBE tests, the effect of fractionation upon the reaction of the mouse testes to x rays, and the effect of sodium menadiol diphosphate (Synkavite) upon the survival curves of *E. coli* and *S. cerevisiae*. Progress was made in determining the recovery rates of the mouse, hamster, and rat from sublethal doses of total-body x irradiation. (For preceding period see UCSF-8.) (C.H.)

#### 6054

Atomic Energy Project, Univ. of Rochester  
STUDIES ON THE ACUTE EFFECTS OF X-IRRADIATION  
AND P-32 ON 21 AND 32 DAY OLD RATS. Melvin R.  
Sikov and Thomas R. Noonan. Aug. 4, 1954. 13p. Contract W-7401-eng-49. (UR-352)

The sensitivity of young rats to x irradiation is greater than that of adult rats. The LD-50/30 days for rats at 21 days of age is 350 r and at 32 days is 420 r. The LD-50 does not differ from that of the adult when irradiation is administered on the 60th day of life. The LD-50/30 days for  $P^{32}$  does not differ significantly from the adult value when the isotope is administered on either the 21st or 32nd day of life, being 4.54 and 4.05  $\mu\text{C/g}$ , respectively. A period of growth depression was found for both types of irradiation at 21 days of age. No definite times of depression are found when the radiation is administered at 32 days of age. (auth)

#### 6055

ON INCONSISTENCIES BETWEEN RADIOHEMATOLOGIC  
OBSERVATIONS. Matts Helde and T. Wahlberg. *Acta Radiol.* 42, 75-80(1954) July.

The relationship between direct and indirect effects of radiation on the blood picture, and factors contributing to inconsistencies in data are discussed. (C.H.)

#### 6056

MEASUREMENT AND CONTROL OF SOME DIRECT AND  
INDIRECT EFFECTS OF X-RADIATION. Felix L. Haas,  
Edna Dudgeon, Frances E. Clayton, and Wilson S. Stone.  
*Genetics* 39, 453-71(1954) July.

Results are reported from investigations made to determine the extent of x-radiation damage due to indirect effects by varying the physiological conditions during irradiation of the test organism, *Drosophila virilis*. Genetic damage was measured as recoverable translocations, which involve breakage and recombination of parts of two or more chromosomes. The effects of temperature, oxygen, carbon monoxide, and carbon dioxide in various combinations were tested, using two rates of irradiation, fast at approximately 2000 r per minute and slow at 100 r per minute. (auth)

#### 6057

GENETIC DRIFT IN IRRADIATED EXPERIMENTAL  
POPULATIONS OF DROSOPHILA MELANOGASTER.

Timothy Prout (Columbia Univ., New York). *Genetics* 39, 529-45(1954) July.

The effect of genetic drift was investigated in three experimental populations of *Drosophila melanogaster*, two of which received treatments with  $\gamma$  rays. Data are reported from studies on the allelism of lethals in the second chromosomes, from which the conclusion is drawn that genetic drift operates in at least small populations. (C. H.)

#### 6058

X-RAY-INDUCED DOMINANT LETHALS IN *DROSOPHILA ROBUSTA*. Armon F. Yanders (Univ. of Nebraska, Lincoln). *Genetics* 39, 558-64(1954) July.

*Drosophila robusta* males, aged ten days or seventeen days, were exposed to 0 (control), 2,500 or 5,000 r of x-rays and mass mated. Eggs were collected at twenty-four-hour intervals for a period of ten days, and records of egg fertility, formation of pupae, and emergence of adult progeny were obtained. Values for induced dominant lethals in the groups aged ten days are similar to the values for *D. melanogaster* at corresponding dosages. Sperm of males aged seventeen days, however, exhibit a greater sensitivity, agreeing with the hypothesis of a greater breakability of chromosomes in sperm of aged males. A gradual decrease in the number of dominant lethals was noted over the ten-day period following irradiation; it is suggested that restitution of induced breaks is responsible. The fact that this increase in fertility is noted throughout the ten-day period over which eggs were collected, with no subsequent drop as noted after seven days with *D. melanogaster*, may indicate that physiological processes involved in spermiogenesis occur at a slower rate in *D. robusta* than in *D. melanogaster*. (auth)

#### 6059

EFFECTS OF BETATRON RADIATIONS ON THE BRAIN OF PRIMATES. Arthur Arnold, Percival Bailey, and John S. Laughlin (Univ. of Illinois Coll. of Medicine, Chicago). *Neurology* 4, 165-78(1954) Mar.

The clinical and pathological effects of 375 to 14,000 r doses of 23-Mev x rays from the Univ. of Ill. betatron on the brain of monkeys are reported and compared with the effectiveness of 225 to 8,400 r doses of 400-kev x rays. A decreased effectiveness was observed with high-energy radiations due to a decrease in the number of ion pairs produced in the same length of pathway (8.5 to 80 ion pairs/ $\mu$ ) in the tissues. The results of irradiation dose rates of 150 r/min with a 1-cm beam and 75 r/min with a 2.5-cm beam are compared. Experimental results on the effects of 7,000 to 14,000, 5,000 to 7,000, 3,000 to 5,000, and 375 to 1,500 r doses (= 4,200 to 8,400, 3,000 to 4,200, 1,800 to 3,000, and 225 to 900 r doses of 400-kev x rays, respectively) of 23-Mev x rays are reported. (J.A.G.)

#### 6060

DEUTERON INACTIVATION OF ADSORBED MONOLAYERS OF BOVINE SERUM ALBUMIN. Franklin Hutchinson and E. R. Mosburg, Jr. (Yale Univ., New Haven, Conn.). *Arch. Biochem. and Biophys.* 51, 436-43(1954) Aug.

The inactivation with deuterons of bovine serum albumin molecules adsorbed on a plane surface of barium stearate is found to be identical with that of albumin monolayers made by spreading the protein on a water surface and transferring to a metal plate. The activity of the BSA is measured by its ability to combine specifically with the homologous rabbit antiserum. Better experimental conditions in this work made it possible to distinguish two types of

antigenic sites operating in BSA molecules, a large type involved in about 75% of the serological activity, and a much smaller site. The larger type is roughly spherical with a molecular weight of about 7000 or 10% of the molecule, but the smaller site is probably less than 1% of the size of the molecule. (auth)

#### 6061

RADIATION-INDUCED CHLOROPHYLL-LESS MUTANTS OF *CHLORELLA*. Edward E. Butler (Univ. of Minnesota, St. Paul). *Science* 120, 274-5(1954) Aug. 13.

#### 6062

RADIATION EFFECTS ON PNEUMOCOCCAL INFECTION PRODUCED BY SUBCUTANEOUS INJECTIONS INTO WHITE MICE. William E. Clapper, James E. Roberts, and Grace H. Meade (The Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). *Proc. Soc. Exptl. Biol. Med.* 86, 420-2(1954) July.

Mice suffering from artificially produced pneumococcal infection showed little or no effect from 350 r x radiation when the radiation exposure was given at the same time as the bacterial inoculation; the time from inoculation to death and the time required for bacteremia to become established were reduced when radiation exposure was given three days prior to inoculation; and the time from inoculation to death and the time from bacteremia to death were reduced when radiation exposure was given 6 days prior to inoculation. (C.H.)

#### 6063

ACETYLATION OF P-AMINOBENZOIC ACID IN X-IRRADIATED RATS. John F. Thomson and Eleanor T. Mikuta (Argonne National Lab., Lemont, Ill.). *Proc. Soc. Exptl. Biol. Med.* 86, 487-8(1954) July.

Rats exposed to 1000 r x radiation retained their capacity to acetylate p-aminobenzoic acid and sulfanilamide for at least 3 days after exposure, an indication that Coenzyme A is not indiscriminately destroyed by whole-body irradiation. (auth)

#### 6064

GROWTH OF VACCINIA VIRUS IN X-IRRADIATED CHICK EMBRYO TISSUES AS STUDIED IN TISSUE CULTURE. N. J. Schneider and F. S. Cheever (Univ. of Pittsburgh Graduate School of Public Health, Penna.). *Proc. Soc. Exptl. Biol. Med.* 86, 591-4 (1954) July.

The effect of x irradiation of chick embryonic tissue has been studied in regard to its subsequent ability to support the multiplication of vaccinia virus in tissue cultures. Under the stated experimental conditions radiation of the tissue in vitro had no significant effect; in contrast, exposure of the embryonic tissue to radiation in ovo appeared to diminish its ability to support viral growth in tissue culture. The differences noted were fairly uniform throughout the period studied. Evidence suggesting that the differences noted are due chiefly to secondary radiation effects is discussed. (auth)

#### 6065

AMPHOPHIL TUMORS OF THE HYPOPHYSIS INDUCED IN MICE BY  $I^{131}$ . Agnes S. Burt, Benjamin H. Landing, and Sheldon C. Sommers (New England Deaconess Hospital, and the Children's Cancer Research Foundation, Boston, Mass.). *Cancer Research* 14, 497-502(1954) Aug.

Histological studies of the hypophyses of 38 C57 mice suggest that the hypophyseal adenomas induced by large doses of  $I^{131}$  are derived from cells which are morphologically similar to the thyrotrophic basophils of rats and to the sparsely granulated basophils or intermediate mucoid cells

of man. The thyroidectomy cells found in the adenomas bear a strong resemblance to the hypertrophic amphophils previously reported in some types of human adrenal hyperactivity and in women with carcinoma of the breast. (C.H.)

6066

AN ABCOPAL EFFECT OF X-RAY UPON MOUSE SPLEEN WEIGHT. Antolin Raventos (Army Medical Service Graduate School, Washington, D. C.). Radiation Research 1, 381-7(1954) Aug.

An attempt was made to distinguish the changes in mouse spleen weight which are due to radiation absorbed by the spleen from those due to radiation absorbed by the remainder of the body. Since the exteriorization procedure used was itself found to have a marked influence on spleen weight, the results obtained apply only to exteriorized spleens and do not necessarily reflect the phenomena that follow irradiation of nonexteriorized spleens. Irradiation of the spleen alone resulted in spleen weights independent of x-ray dosage over the range 300 to 750 r. Irradiation of the spleen plus the remainder of the body resulted in spleen weight losses showing a marked dependence on x-ray dosage. It was assumed that no significant recovery of spleen weight occurs in 5 days. It is concluded that irradiation of the remainder of the body probably provokes splenic atrophy, perhaps through adrenal cortical action. Irradiation of the body did not produce spleen weight loss when the spleen was shielded, and it is suggested that the shielded spleen is able to respond to the hematopoietic needs of the irradiated animal. (auth)

6067

ON THE QUESTION OF THE TOLERANCE DOSE OF HUMAN ORGANISMS ON INHALATION OF RADIUM EMANATION. O. Henn (Universitat Innsbruck, Vorstand, Germany). Strahlentherapie 94, No. 3, 441-54(1954). (In German).

The results obtained in examinations of human bone marrow suggest that the tolerance dose for radium emanation has to be estimated lower by 1 to 2 decimal powers, than that for roentgen and gamma rays. Apart from other factors, an essential causal importance is attributed to the specific organotropy of radium emanation. (auth)

6068

THE EFFECTS OF CORTISONE ON THE DEVELOPMENT OF SPONTANEOUS LEUKEMIA IN MICE AND ON ITS INDUCTION BY IRRADIATION. A. C. Upton and J. Furth (Oak Ridge National Lab., Tenn.). Blood 9, 686-95(1954) July.

The development of spontaneous lymphoma in a high-leukemia strain of mice was inhibited by administration of cortisone, although the hormone-induced atrophy of the thymus and other lymphoid tissues was only transient. Inhibition of lymphoma formation resulted from only three successive daily injections of cortisone but was greater if the cortisone administration was prolonged for three months. A high incidence of myeloid leukemia was induced in a low-leukemia strain of mice by a single exposure to 350 r of x radiation. Cortisone was without effect on the induction of myeloid leukemia. Cortisone preirradiation increased, and postirradiation decreased, the incidence of radiation-induced lymphomas in male mice. (auth)

6069

INDUCTION OF STERILITY IN MALE MICE BY CHRONIC GAMMA IRRADIATION. T. C. Carter, Mary F. Lyon, and Rita J. S. Phillips (Institute of Animal Genetics, Edinburgh, Scotland). Brit. J. Radiol. 27, 418-22(1954) Aug.

Male CBA inbred mice exposed to radium  $\gamma$  rays at a dose rate of 33.3 r/week showed a decrease in fertility with the following characteristics: onset, 330 r; median dose, 430 r; 100 per cent, 550 r. At a dose rate of 8.0 r/week a 200-r dose induced sterility in 39 per cent of the mice. At a dose rate of 1.64 r/week, a 40-r dose was followed by a slight (14 per cent), but probably real, increase in sterility which may have been brought about by acceleration of the normal ageing processes. CBA males may be more sensitive than other inbred mice to radiosterilization. (auth)

## RADIATION HAZARDS AND PROTECTION

6070

General Electric Co., ANP Project  
COMMUNITY AIR MONITORING PROGRAM OF GE-ANP.  
R. E. Baker. June 1, 1953. 17p. (DC-53-6-72)

The air monitoring program of the GE-ANP group at Lockland, Ohio, is described. (K.S.)

6071

HISTOPATHOLOGICAL EXAMINATION OF MICE IRRADIATED AFTER INJECTION WITH CYSTEINAMINE. M. A. Gerebtzoff and Z. M. Bacq. (Univ. of Liège, Belgium). Experientia 10, 341-3(1954) Aug. (In French).

The injection of  $\beta$ -mercaptoethylamine to C-57 black mice before irradiation (700 r) effects a partial protection of liver and spleen. It has a strong accelerating action on regeneration in the spleen, intestine, and probably thymus. The experiments suggest that this action is related to a protection of glucidic metabolism. (auth)

6072

DECREASE OF RADIOSENSITIVITY OF THE ADULT RAT IN DEEP HYPOTHERMY. S. Hajduković, A. Hervé, and V. Vidović. (Univ. of Liège, Belgium). Experientia 10, 343-4(1954) Aug. (In French).

Using an appropriate technique, adult rats of both sexes were put under deep hypothermy (rectal temperature of 14 to 15°C). Under these conditions, the respiration and the cardiac rhythm are definitely slowed down. Rats irradiated in a state of deep hypothermy with lethal doses of 800 and 900 r of x rays, are partially protected; 50% of these animals survived more than 30 days, whereas all control animals died after 17 days. The same degree of protection is obtained if the cooling is made in the presence of oxygen or under an air pressure of 1.25 atmosphere. (auth)

6073

PROTECTIVE EFFECTS OF COMBINED HYPOXIA AND CYSTEINE TREATMENT ON WHOLE-BODY IRRADIATION OF MICE. Finn Devik (Univ. of Oslo, Norway). Brit. J. Radiol. 27, 463-6(1954) Aug.

Mice were exposed to 200, 600, 800, and 1100 r of x rays at 170 to 190 kv. The frequency of irradiation-induced chromosome injuries in the bone marrow and the acute lethality were both used to indicate the protective effects of buffered cysteine hydrochloride and hypoxia. The protective effect observed after administration of suboptimal amounts of cysteine and hypoxia were increased in both series of experiments when cysteine and hypoxia treatments were combined. Comparing the results of the lethality series and the chromosomal series, no great discrepancies are noted. The significance of the variations is discussed. The protective effect of D-cysteine was found to be the same as that of L-cysteine, which is considered to favor a radiochemical rather than a biochemical interpretation of the protective action of cysteine. (auth)

6074

INVESTIGATIONS ON A BIOLOGICAL RADIATION PROTECTION. VII. THE INFLUENCE OF NARCOTICS ON RADIATION INJURED MICE. H. Langendorff and R. Koch *Strahlentherapie* 94, No. 3, 411-20(1954). (In German).

An investigation of the influence of different narcotics on the biological effect of radiations is reported. It was found that ether and urethane are apt to increase the radiosensitivity of mice while same is being reduced by the action of ethyl alcohol or Megaphen + Dolantin. Different barbiturates as well as Megaphen alone did not influence the radiosensitivity of the animals. (auth)

## RADIATION SICKNESS

6075

RADIATION SICKNESS. A STUDY OF ITS RELATION TO ADRENAL CORTICAL FUNCTION AND THE ABSOLUTE EOSINOPHIL COUNT. Elliott C. Lasser and K. Wilhelm Stenstrom (Univ. of Minnesota Hospitals, Minneapolis). *Am. J. Roentgenol. Radium Therapy Nuclear Med.* 72, 474-87 (1954) Sept.

Forty female patients, receiving external irradiation of the pelvic areas over periods of about a month under certain standardized conditions, form the basis of a study of radiation sickness. In these patients, adrenal cortical reserve, as signified by a modification of the Thorn ACTH-eosinophil four-hour response, was found to be within the range of normal initially but to have fallen considerably below normal at the end of ten to fourteen days. Continued irradiation does not prevent a gradual return of this index of adrenal cortical reserve to normal, or near normal, by thirty to thirty-four days. The basal absolute eosinophil count in these patients, after a slight drop in the first week or so, begins to climb well above normal and reaches its highest point in twenty to twenty-four days, after which a slight return toward normal is noted. A symptom index, derived in uniform fashion from the number and severity of symptoms of radiation sickness found to be present (or absent) in each patient after daily interrogation showed changes parallel to those noted for the absolute eosinophil counts. Consideration of curves established for the above three factors suggests that the adrenal cortex undergoes definite changes in the course of irradiation, but these are probably not related to radiation sickness, and that the similarity of the direction of change of the symptom indexes and the absolute eosinophil counts suggests an etiological factor common to both. Evidence is presented to indicate that individuals with presumably low estrogen levels suffer a greater severity of radiation sickness than individuals with evidence of more adequate levels. The literature has been reviewed in regard to the findings of this study, and, where possible, comparisons have been established. (auth)

## RADIOTHERAPY

6076

DISTRIBUTION OF COLLOIDAL RADIOACTIVE CHROMIC PHOSPHATE AFTER INTRACAVITARY ADMINISTRATION. Samuel W. Root, Malcolm P. Tyor, Gould A. Andrews, and Ralph M. Kniseley (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn). *Radiology* 63, 251-9(1954) Aug.

Preliminary studies indicate that the distribution of chromic phosphate after intracavitary injection is similar in most respects to that of colloidal radioactive gold. There is evidence, however, for some ionization of the chromic phos-

phate and this ionized portion follows the distribution expected for phosphate ion. From the point of view of distribution, chromic phosphate appears to be suitable for intracavitary therapeutic use. (auth).

## TOXICOLOGY STUDIES

6077

Hanford Works

RELATIVE EFFECTIVENESS OF VARIOUS AGENTS FOR PREVENTING THE INTERNAL DEPOSITION OF PLUTONIUM IN THE RAT. J. Katz, M. H. Weeks, and W. D. Oakley. Jan. 1, 1954. 12p. Contract W-31-109-Eng-52. (HW-30231)

The prompt administration of zirconium citrate was at least twice as effective as the prompt administration of the calcium disodium salt of ethylenediaminetetraacetic acid (CaEDTA) in preventing deposition of plutonium in the skeleton. On the other hand, CaEDTA was twice as effective as zirconium citrate in preventing the deposition of plutonium in soft tissues. The combined administration of zirconium citrate and CaEDTA was the most effective treatment for preventing the deposition of plutonium in the total rat. This combined treatment reduced by about two-thirds the plutonium retained after 30 days. Zirconium malate offered no advantage over zirconium citrate, and appeared to be somewhat more toxic. Three doses of the zirconium salts over a four-day period were no more effective than a single dose. All forms of therapy (single injection) initiated 30 days after plutonium administration were ineffective in removing the plutonium fixed in the body of the rat. Various skeletal segments were separately analyzed in both control and therapeutically treated rats and were shown to exhibit a comparable affinity for plutonium with the exception that bones of the skull were found to contain a lower concentration of plutonium by a factor of about two. (auth)

6078

Hanford Works

INFLUENCE OF PLUTONIUM CONCENTRATION ON EFFECTIVENESS OF THERAPEUTIC AGENTS. M. H. Weeks, W. D. Oakley, and R. C. Thompson. Aug. 1, 1954. 9p. Contract W-31-109-Eng-52. (HW-32399)

The retention of plutonium in bone and soft tissue of rats was not significantly different in animals administered plutonium in amounts varying by a factor of  $10^5$ . The effects of zirconium citrate and CaEDTA in preventing retention of plutonium were not significantly influenced by the plutonium concentration. (auth)

6079

Mound Lab.

BIOLOGICAL RESEARCH QUARTERLY PROGRESS REPORT THROUGH JUNE 17, 1954. D. S. Anthony. July 13, 1954. 15p. Contract AT-33-1-GEN-53. (MLM-989)

There is no indication that maintenance of an average body concentration of  $0.01 \mu\text{C Po/kg}$  of body weight in rats for the duration of their adult life has any effect on body weight tumor incidence, or longevity. Graphs show rate of excretion of Po and concentration of Po in liver, carcass, and kidneys following gavage and intravenous administration. Progress on the following studies is reported briefly: the gross effects of Ac on rats and mice; mouse toxicity resulting from eating dead animals; effects of Ac on reproduction of the rat; myelogenous leukemia induced by low doses of Ac and its transfer to young Sprague-Dawley

rats; chemical inhibition of cell division. (A.G.W.)

# 6080

Atomic Energy Project, Univ. of Calif., Los Angeles  
A STUDY OF THE PHARMACOLOGICAL EFFECTS OF  
TETROPHAN, (3,4-DIHYDRO-1,2-BENZACRIDINE-5-  
CARBOXYLIC ACID). Thomas J. Haley and W. G.  
McCormick. Sept. 8, 1954. 16p. Contract AT-04-1-GEN-  
12. (UCLA-303)

Acute toxicity symptoms produced by the Tetrophan consist of tetanic convulsions, general lethargy, Cheyne-Stokes respiration, and death by cardio-vascular collapse followed by respiratory failure. Tetrophan increased sleeping time in mice given pentobarbital or mephenesin, and neither of these drugs was able to block the convulsions which were shown to be due to a direct effect of Tetrophan on the muscles. Tetrophan had no effect on the intestines *in vitro* or *in vivo*, and it had no cholinergic or adrenergic blocking actions. In the cat, Tetrophan produced a transient vasodepression at low doses and cardio-vascular collapse at high doses. A transient apnea which was not modified by atropine, hexamethonium chloride, or pyrilamine maleate was also observed. A prolonged negative inotropic effect was observed when the isolated guinea pig heart was exposed to Tetrophan. At the higher doses, the drug also produced a negative chronotropic effect and a reduction in coronary flow. Changes in the electrocardiogram resembling those seen in digitalis toxicity were observed after intravenous injection of 5 to 40 mg/kg of Tetrophan. (auth)

# 6081

Atomic Energy Project, Univ. of Rochester  
NICKEL CARBONYL, REVIEW OF LITERATURE. F. L.  
Haven. July 14, 1954. 17p. Contract W-7401-eng-49.  
(UR-347)

Nickel carbonyl has been shown to be a highly toxic substance. The symptoms and effects of inhalation of the compound are described, including its activity as a suspected carcinogen for the lungs. The mechanism of action, permissible limits for rabbits, recommended safe amount for 8-hour exposure, and meager data on therapeutics and prophylaxis in rats are given. (auth)

## TRACER APPLICATIONS

# 6082

Atomic Energy Medical Research Project, Western  
Reserve Univ.  
CLINICAL CLEARANCE RATE MEASUREMENTS FOR THE  
ACCUMULATION OF  $I^{131}$  BY THE THYROID GLAND.  
PART 1. METHODS. William J. MacIntyre, John P.  
Storaasli, Keith Weigle, and Hymer L. Friedell. Aug. 27,  
1954. 19p. Contract W-31-109-eng-78. (NYO-4966)

The radioiodine clearance test is compared with the measurement of radioactive uptake level for the evaluation of thyroid function. Techniques of clearance rate measurements and data obtained on a number of patients with various types of thyroid dysfunction are presented. (C.H.)

## CHEMISTRY

# 6083

Oregon Univ.  
STUDIES ON THE ANODIC POLARIZATION OF  
ZIRCONIUM—GROWTH RATES AND THICKNESSES OF

THE VERY THIN ANODIC OXIDE FILMS. George B.  
Adams, Jr., Mario Maraghini, and Pierre Van  
Rysseberghe. July 1954. 34p. Contract AT(45-1)-535.  
(AECU-2918)

Methods for making quantitative studies on the growth of very thin oxide films on zirconium and for estimating the film thickness as this growth progresses are described. These methods have been shown to be internally consistent and have been correlated with Mott's theory of metal oxidation. Experimental results so obtained have been found to be in agreement with previous work. The methods should be readily adaptable to studies on the effect of temperature, ultraviolet radiation, adsorption at the double layer, electrolyte, and metal composition and physical properties on the ionic current causing oxide film growth. (auth)

# 6084

Rensselaer Polytechnic Inst.  
A STUDY OF THE EXPLOSIVE OXIDATION OF DIBORANE  
[thesis]. Walter Roth. May 1954. 73p. [For Mathieson  
Chemical Corp. on Contract Noa(s)-52-1023-c]. (MCC-  
1023-TR-29).

The explosion limits of mixtures of diborane and oxygen were studied with the greatest emphasis being placed on the second explosion limit. The diameter of the reaction was found to have no significant effect on the position of the second limit. The change in the position of the second limit with variation of diborane-oxygen concentration ratio and with the addition of inert gases could be represented by the equation,  $\Sigma k_M f_M = CT_2 \exp(-\Delta E/RT_2)$ ,  $M = B_2H_6, O_2, N_2, He$ , etc., where  $k_M$  is the rate constant of a chain-breaking reaction involving the molecule,  $M$ , as a third body, and  $f_M$  is the mole fraction of gas  $M$ .  $C$  is a constant at constant pressure,  $T_2$  is the second limit explosion temperature at constant pressure, and  $\Delta E$  is the difference in activation energies of a chain-branching and a chain-breaking reaction. The experimental results have been used, in conjunction with the equation, to show that  $\Delta E \approx 2$  kcal/mole and that the relative third-body efficiencies of the gases studied are as follows:  $B_2H_6$ , 1;  $O_2$ , 1.50;  $N_2$ , 1.38;  $He$ , 1.38; and  $A$ , 1.28. These are shown to agree with the theoretical efficiencies. (auth)

# 6085

Yale Univ.  
INTENSITY MEASUREMENTS APPLIED TO GOUY DIFFU-  
SIOMETRY. John F. Riley and Philip A. Lyons. June 28,  
1954. 20p. Contract AT(30-1)-1375. (NYO-6404)

A method is described which has been used to verify the intensity distribution in the lower fringes in a Gouy diffusion fringe pattern predicted by the general theory for the Gouy method for measuring diffusion coefficients in solution. The position of the zeroth turning point predicted by the theory has also been shown to be correct. Two techniques for the direct recording of Gouy diffusion data for use in the actual determination of diffusion coefficients are presented briefly. (auth)

# 6086

Yale Univ.  
THE ACTIVITY COEFFICIENT OF HYDROCHLORIC ACID  
IN CONCENTRATED AQUEOUS HIGHER VALENCE TYPE  
CHLORIDE SOLUTIONS AT 25°. 1. THE SYSTEM:  
HYDROCHLORIC ACID-BARIUM CHLORIDE. Herbert S.  
Harned and Robert Gary. Aug. 17, 1954. 15p. Contract  
AT(30-1)-1375. (NYO-6607)

From electromotive force measurements of suitable

cells, the activity coefficient of hydrochloric acid in barium chloride solutions has been computed in mixtures of 1, 2, and 3 ionic strengths. It is shown that at these concentrations, the logarithm of the activity coefficient of the acid varies linearly with the acid concentration. Following a procedure adopted by Harned which employed the Gibbs-Duhem equation and considerations arising from the application of cross differentiation relations as suggested by Glueckauf, these data are subjected to a critical examination. (auth)

6087

Radiological Defense Lab.

AN ESTIMATE OF THE PREDOMINANT CHEMICAL SPECIES RESULTING FROM A SHALLOW UNDER WATER BURST OF AN ATOMIC BOMB. L. R. Bunney and N. E. Ballou. Feb. 5, 1954. 26p. (USNRDL-435)

Estimates, based on available experimental and theoretical information, are given of the predominant chemical species resulting from a shallow underwater burst of an atomic bomb. The physical states of these species are also estimated. The halides, alkali metals, and alkaline earth metals should appear as ionic species in their normal valence states. Several other elements, i.e., B, P, S, Ge, As, Mo, Te, and Tl, should occur as oxygenated anions; nearly all of the remaining elements should exist as oxides or hydrated oxides associated with colloidal or gross particulate matter. Discussions of the pertinent chemical properties of each element are also presented. (auth)

6088

Naval Radiological Defense Lab.

PHYSICAL STATE OF FISSION PRODUCT ELEMENTS FOLLOWING THEIR VAPORIZATION IN DISTILLED WATER AND SEAWATER. A. E. Greendale and N. E. Ballou. Feb. 16, 1954. 28p. (USNRDL-436).

An estimate has been made of the physical state of selected fission product elements following an underwater atomic bomb detonation by simulating the conditions of vaporization with a carbon arc. Behavior of fission product elements in distilled water as well as synthetic seawater has been studied. In distilled water following an underwater vaporization, the elements iodine, cesium, and molybdenum were largely present as ions while the majority of the fission product elements were colloidal or particulate. In the seawater solutions, the elements iodine, strontium, antimony, and cesium were mainly in the ionic state with tellurium somewhat less ionic. Molybdenum was present chiefly as a colloid or particulate, while the other elements studied, cerium, niobium, ruthenium, yttrium, and zirconium were essentially particulate. An attempt has been made to interpret the distribution of the fission products based on reactions of fission product chemical species with distilled water and seawater. (auth)

6089

THE THEORY OF SLOW HETEROGENEOUS REACTIONS IN A MOVING LIQUID. V. G. Levich and N. N. Meiman. Translated from Doklady Akad. Nauk. S.S.S.R. 79, 97-100 (1951). 7p. (AERE-Trans-11/3/5/246; AEC-tr-1376)

A solution is obtained for the equation of convective diffusion under the boundary condition  $D(dc/dn) = \beta c$  (where  $\beta$  is a constant, the value of  $c$  and  $dc/dn$  are taken at the interface and  $D$  denotes the diffusion coefficient) at the surface of a semi-infinite plate. (J.S.R.)

6090

DI-TERT.-BUTYLBERYLLIUM AND BERYLLIUM HYDRIDE.

G. E. Coates and F. Glockling (Univ. of Bristol, England). *J. Chem. Soc.* 2526-9(1954) July.

Di-tert.-butylberyllium, prepared from tert.-butylmagnesium chloride and beryllium chloride, decomposes rapidly above 100° to give mainly beryllium hydride,  $\text{BeH}_2$ , and isobutene. The hydride, which is stable up to 240°, forms bisdimethylaminoberyllium with dimethylamine, and beryllium borohydride with diborane, and is slowly hydrolyzed by water. (auth)

6091

THE DISTRIBUTION OF RUTHENIUM TETROXIDE BETWEEN CARBON TETRACHLORIDE AND AQUEOUS ALKALI, ACID, AND NEUTRAL SALT SOLUTIONS. F. S. Martin (Atomic Energy Research Establishment, Harwell, Berks, England). *J. Chem. Soc.*, 2564-70(1954) July.

Vapor pressure and distribution measurements show that solutions of ruthenium tetrachloride are ideal below 0.2M. The presence of neutral salts salts-out ruthenium tetroxide in a manner exactly analogous to that of other nonpolar nonelectrolytes, e.g., benzene. Distribution experiments using dilute alkalis show that the tetroxide behaves as a weak acid with dissociation constant for the first hydrogen ion of  $6.8 \pm 0.3 \times 10^{-12}$  in aqueous solution. Similar experiments with dilute acids indicate that it is probably also a very weak base of dissociation constant about  $5.7 \times 10^{-15}$ . The acid dissociation constant is discussed in connection with the probable structure of  $\text{RuO}_4$ , using Kossiakoff and Harker's theory of inorganic oxy-acids as modified by Ricci (*J. Am. Chem. Soc.* 70, 109(1948)). (auth)

6092

CHEMICAL FORM OF PHOSPHORUS-32 PRODUCED IN ALUMINIUM BY BOMBARDMENT WITH NITROGEN. G. A. Chackett and K. F. Chackett (Univ. of Birmingham, England). *Nature* 174, 232-3(1954) July 31.

The chemical state of  $\text{P}^{32}$  atoms produced by bombardment of  $\text{Al}^{27}$  with  $^{14}\text{N}^{+}$  ions is discussed. Results indicate that on dissolving a bombarded Al foil in NaOH solution in absence of air, about  $\frac{1}{2}$  of the recovered activity is carried by gaseous  $\text{PH}_3$  and the remainder enters solution as a reduced oxyphosphorus ion, probably hypophosphite. The proportion forming phosphate ion was undetectable without the use of drastic oxidizing conditions. In addition, the experiment suggested that radioactive  $\text{PH}_3$  is a true primary chemical reaction product, that an intermediate valency state existed between  $\text{P}^{32}$  in the form of the phosphate and phosphide ions, and that all the  $\text{P}^{32}$  must have been able to find a site of minimum potential energy. On the basis of their reactions with water molecules, H ions, OH ions, and H atoms produced by the reaction of neighboring Al atoms with the dissolving solution, it was postulated that the  $\text{P}^{32}$  atoms are all present in a very low, or even zero, state of charge, and the reaction yields reflect competition between over-all reactions such as:  $\text{P} + 3\text{H} \rightarrow \text{PH}_3$ ;  $\text{P} + 2\text{H}_2\text{O} \rightarrow \text{H}_2\text{PO}_2 + \text{H}$ ;  $\text{P}^+ + 4\text{H} \rightarrow \text{PH}_3 + \text{H}^+$ ;  $\text{P}^+ + 2\text{H}_2\text{O} \rightarrow \text{H}_2\text{PO}_2 + \text{H}^+$ . (J.A.G.)

6093

THE ENTROPIES OF AQUEOUS IONS. R. E. Powell (Univ. of California, Berkeley). *J. Phys. Chem.* 58, 528-33(1954) July.

Since the binding of a water molecule to an ion will occur with a decrease in entropy, the partial molal entropies of various ions can be correlated with their respective degrees of hydration. The literature on the entropies of individual ions is surveyed from this point of view. The entropies of monatomic ions, oxygenated ions, and complex ions of both

positive and negative charges can be systematized on the basis of their sizes and charges. The same treatment is applicable to ionic activated complexes, permitting the rationalization of the entropies of activation for reactions involving ions. Simple theoretical treatments, which regard the water as a continuous medium, or which regard water molecules as frozen to the ions, can be refined by taking into account the interaction of the ionic charge with the individual water dipoles. (auth)

6094

ELECTROCHEMICAL INVESTIGATIONS ON RUTHENIUM BY THE METHOD OF RADIOACTIVE INDICATORS. I. ANODIC PROCESSES. M. A. El Guebely and M. Halssinsky (Institut du Radium, Paris, France). *J. chim. phys.* 51, 290-5 (1954) June. (In French).

The anodic oxidation of  $\text{Ru}(\text{SO}_4)_3$ ,  $2 \times 10^{-2}$  M in acid solution, which leads to  $\text{RuO}_4$ , is accomplished by successive steps to the IV and VI valences and by the formation of an intermediate colloid which is an oxide of  $\text{Ru}^{+4}$ . The appearance of each new valence state and the speed of formation and disappearance depend on the potential applied to the anode (Au, Pd, or Pt). The same process appears in reverse order by reduction with a Pt cathode.  $\text{Ru}(\text{SO}_4)_3$  disproportionates to  $\text{Ru}^{+4}$  and volatile  $\text{RuO}_4$ . The formation of an anodic deposit of Ru characterized by a critical potential in which the value depends on the nature of the electrode, Au, Pt, or Pd, was noted. This deposit is probably equivalent to the processes of the formation of the colloidal oxide in a more concentrated solution. With the augmentation of the anode potential, the deposit increases at first and then sharply diminishes. It is shown that the decrease corresponds to the formation of  $\text{RuO}_4$  which escapes from the solution and is decomposed on reducing surfaces to give probably  $\text{RuO}_2$ . (tr-auth)

6095

ON THE REACTIONS IN SOLUTION BETWEEN ZIRCONIUM NITRATES AND THE ALKALI METAL IODATES. I. M. I. Konarev and A. S. Solovkin. *Zhur. Obshchei Khim.* 26(86), 1113-18 (1954) July. (In Russian).

The addition of  $\text{KIO}_3$  to solutions of  $\text{Zr}(\text{NO}_3)_4$  precipitates a hydroxy compound with the composition of 1 to 3 iodate radicals to 1 atom of Zr. The quantity of iodate ions added depends on the quantity of  $\text{KIO}_3$  as well as the acidity of the solution. By use of  $\text{KIO}_3$  as the precipitating agent for Zr, stable precipitates of the tetraiodate do not form. On precipitation of Zr from aqueous solutions of its nitrate with  $\text{KIO}_3$  the monoiodate  $\text{Zr}(\text{OH})_3\text{IO}_3 \cdot 4\text{H}_2\text{O}$  is formed between pH 2 and pH 3. The addition of excess  $\text{KIO}_3$  to the nitrate solution yields  $\text{ZrOH}(\text{IO}_3)_3 \cdot 4\text{H}_2\text{O}$ . (J.S.R.)

## AEROSOLS

6096

THE FLOW METHOD OF ULTRAMICROSCOPE MEASUREMENT OF THE PARTICLE CONCENTRATION OF AEROSOLS AND OTHER DISPERSION SYSTEMS. B. Deriagin and G. Vlasenko. Translated by E. Hope from *Doklady Akad. Nauk S.S.S.R.* 63, 155-8 (1948). 4p. (AEC-tr-940)

The method of flow ultramicroscopy consists of making a particle count in a continuous stream of aerosols flowing in a direction parallel to the line of sight with the particle traversing a zone of illumination in a set time. The apparatus used is described in detail, and the advantages of the method are discussed. (J.S.R.)

## ANALYTICAL PROCEDURES

6097

Atomic Energy Research Establishment, Harwell, Berks (England)

THE DETERMINATION OF URANIUM AND THORIUM IN URANIUM-THORIUM ALLOYS. E. Furby. May 1954. 14p. (AERE-C/R-1435).

A method is described for the determination of uranium and thorium in binary alloys of the two metals. The uranium determination is carried out volumetrically by reduction of the perchloric acid solution of the alloy with liquid zinc amalgam, followed by titration with standard ceric sulphate. Thorium is estimated by direct titration of the alloy solution with standard ethylenediaminetetraacetic acid except where the uranium content of the alloy exceeds 60% when a preliminary separation of the thorium becomes necessary. This separation is achieved by the precipitation of thorium benzoate, which is redissolved for subsequent volumetric (EDTA) finish. The method covers all proportions of the alloying constituents from 5 to 95%, and an accuracy better than  $\pm 1\%$  is attained. (auth)

6098

Argonne National Lab.

THIOCYANATE SPECTROPHOTOMETRIC ANALYSIS OF TITANIUM, VANADIUM, AND NIOBIUM. C. E. Crouthamel, C. E. Johnson, and B. E. Hjelt. Aug. 1954. 25p. Contract W-31-109-eng-38. (ANL-5303)

A thiocyanate spectrophotometric method was applied to the determination of titanium, vanadium, and niobium. The complexity of the species in solution is discussed, and the existence of reactive and nonreactive forms under various conditions are demonstrated. The maximum molar absorbance indices of Ti(IV), V(III), and Nb(V) have been determined. The formation of the tantalum thiocyanate complex was judged not useful for analytical purposes. Hafnium and zirconium did not develop an appreciable absorbance in the thiocyanate acetone-aqueous medium. (auth)

6099

Oklahoma Agricultural and Mechanical Coll.

DETERMINATION OF CARBON, HYDROGEN, AND NITROGEN IN ORGANOBORON COMPOUNDS. P. Arthur, R. Annino, and W. P. Donohoo. Aug. 24, 1954. 11p. [For Callery Chemical Co., Contract NOa(s)-52-1024-C]. (CCC-1024-TR-39)

By use of a quartz combustion tube and high temperatures (1000°C), carbon analyses were obtained for organoboron compounds which are comparable with those for ordinary organic compounds. Both the accuracy and precision are highly acceptable. The hydrogen analyses, although high, were no further off than normally encountered with organic compounds. A modified Dumas method was used to obtain accurate nitrogen analyses. (auth)

5100

West Virginia Univ.

RESEARCH AND DEVELOPMENT ON HIGH-FREQUENCY FIELDS FOR CHEMICAL ANALYSIS. CONDUCTOMETRIC TITRATIONS WITH DIMETHYLGLYOXIME. TECHNICAL REPORT NO. 5 [FOR] SEPTEMBER 16, 1953-AUGUST 1, 1954. James L. Hall, John A. Gibson, Jr., Harold O. Phillips, and Paul R. Wilkinson. 8p. Contract DA-36-061-ORD-383. (NP-5296).

A study was made of the conditions under which conductometric methods, including high-frequency methods, may be used to determine the end point for the titration of solu-

tion of  $N^{+3}$  ions and dimethylglyoxime. It was shown that for some titrations of dimethylglyoxime with Co, Ni, Pb, and Mn, no changes occur under the conditions specified which permit detection of the end points by two types of high-frequency apparatus or by a conventional conductance method. (J.E.D.)

#### 5101

Chalk River Project (Canada)  
RAPID DETERMINATION OF STRONTIUM ACTIVITY IN A MIXED FISSION PRODUCT SOLUTION. E. Mizzan. June 1, 1954. 13p. (PDB-122)

A rapid method is presented for the determination of strontium activity in the presence of the relatively long-lived fission product activities. The extraneous activities, with the exception of cesium, are removed by an yttrium hydroxide scavenging. The strontium is separated from the cesium in the supernatant solution by a strontium oxalate precipitation. The oxalate precipitate is then transferred to an aluminium disc to be dried and counted for strontium activity. The results agree with those obtained by the fuming nitric acid procedure. The precision of the method is  $\pm 3\%$ . Decontamination from the other long-lived fission product activities is very good. The method is much shorter and safer than the fuming nitric acid procedure. (auth)

#### 5102

Stanford Research Inst.  
METHODS OF EVALUATING HEAT AND EROSION RESISTANT MATERIALS. TECHNICAL REPORT NO. 1. ION-SCATTERING ANALYSIS OF METAL SURFACES. Sylvan Rubin. June 4, 1954. 52p. Contract DA-04-200-ORD-115. (WAL-370/13-24)

An ion scattering method is reported which detects the elements present in a surface without regard to whether they are either in a crystalline or amorphous form. The method of analysis is based on the change in momentum of an elastically scattered particle as a function of the mass of the scattering atom. The particles scattered from the sample provide the information for the analysis, since the ratio of their momenta after scattering to their initial momentum is a function of the nuclear masses by which they are scattered. (J.E.D.)

#### 5103

SPECTROPHOTOMETRIC AND POLAROGRAPHIC DETERMINATIONS OF SOLUBLE SILICATE. Michael A. DeSesa and Lockhart B. Rogers (Massachusetts Inst. of Tech. Cambridge). *Anal. Chem.* 26, 1278-84(1954) Aug.

A spectrophotometric method for the rapid determination of low percentages of silica in Mg oxide and carbonate based on the measurement of yellow molybdosilicic acids is reported, including conditions of color development and minimizing interferences. Measurement of the absorbancy in the ultraviolet against an appropriate blank increased the sensitivity to about the same as that obtained by reduction to the blue complex when the measurements were made at 332 m $\mu$ . A polarographic procedure for determining silica by reduction of the molybdosilicic acid complex at the dropping Hg electrode is presented. The best shaped waves were obtained by using 1M  $NH_4NO_3$  as the supporting electrolyte with 0.001% gelatin present as maximum suppressor. Studies were made to determine the feasibility of using Zr fluoride and  $NH_4OH$  to solubilize colloidal silica prior to spectrophotometric determination. The latter proved to be better when the nature of the sample permits it to be made alkaline. (J.A.G.)

#### 5104

POLAROGRAPHIC DETERMINATION OF MOLYBDENUM (VI). TARTARIC ACID AS SUPPORTING ELECTROLYTE. E. P. Parry and M. G. Yakubik (Univ. of Connecticut, Storrs). *Anal. Chem.* 26, 1294-7(1954) Aug.

A rapid method for the polarographic determination of molybdenum(VI) in the presence of tungsten(VI) is presented. A supporting electrolyte of tartaric acid was found very suitable for such a determination. In the presence of tartaric acid, molybdenum(VI) is reduced in two steps, the total height of the two waves being proportional to the molybdenum concentration. Tungsten(VI) is not reduced under these conditions. The reducible molybdate species must be absorbed before reduction can occur. Because of this adsorption, the presence of indifferent salts decreases slightly the total wave height; the use of the method of standard additions is therefore most convenient for the determination. Methods for overcoming interference due to iron(III) and chromium(III) are described. Nickel(II), cobalt(II), and other substances reduced at potentials more negative than -0.75 v vs. the saturated calomel electrode do not interfere. The method is rapid, accurate, convenient, and subject to few interferences. (auth)

#### 5105

POLAROGRAPHIC DETERMINATION OF TUNGSTEN IN ROCKS. Laura E. Reichen (U. S. Geological Survey, Washington, D. C.). *Anal. Chem.* 26, 1302-4(1954) Aug.

A simpler and faster method than the classical gravimetric procedure for the determination of tungsten in rocks and ores is presented. A new polarographic wave of tungsten is obtained in a supporting electrolyte of dilute hydrochloric acid containing tartrate ion. This permits the determination of tungsten both rapidly and accurately. No precipitation of the tungsten is necessary, and only the iron need be separated from the tungsten. The accuracy is within the limits of a polarographic procedure; comparison of polarographic and gravimetric results is given. The method reduces appreciably the amount of time ordinarily consumed in determination of tungsten. (auth)

#### 5106

RADIOACTIVITY ASSAY OF WATER AND INDUSTRIAL WASTES WITH INTERNAL PROPORTIONAL COUNTER. Lloyd R. Setter, Abraham S. Goldin, and John S. Nader (Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio). *Anal. Chem.* 26, 1304-6(1954) Aug.

A method for determining low levels of nonvolatile radioactive contamination in water is proposed. The suspended and dissolved radioactivities are separated by filtration and evaporation. This permits counting both the  $\alpha$  and  $\beta$  radiation at levels less than the maximum permissible concentration of unknown isotopes in drinking water. When a 250-ml sample of water containing about 50  $\mu\mu\text{c/liter}$  is prepared and counted for 30 min, the activity may be assayed with an accuracy (at the 95% confidence limit) of 10% for  $\alpha$  and 20% for  $\beta$  radiation. Levels as low as 10  $\mu\mu\text{c/liter}$  ( $\beta$ ) and 2  $\mu\mu\text{c/liter}$  ( $\alpha$ ) are detectable. Such sensitivity and accuracy are made possible by counting the dry solids spread over a large area and by using instruments with efficient counting characteristics. (auth)

#### 5107

TITRATION OF BISMUTH WITH ETHYLENEDIAMINETETRAACETIC ACID. SPECTROPHOTOMETRIC END POINTS. A. L. Underwood (Emory Univ., Georgia). *Anal. Chem.* 26, 1322-4(1954) Aug.

Prior to the development of ethylenediaminetetraacetic acid, the volumetric methods for determining bismuth were

indirect and unsatisfactory. Since this reagent offers a simple and direct titration but suffers from a lack of good indicators, an attempt has been made to extend its usefulness by application of the photometric titration technique. The progress of the titration may be assessed by following spectrophotometrically the disappearance of the yellow bismuth-thiourea complex, or the appearance of the blue complex formed by cupric ion with the titrant. Quantities of bismuth from 0.5 to 100 mg can be titrated accurately when present in a volume of 100 ml. Large quantities of lead do not interfere with the titration, and bismuth can be determined rapidly in a mixture with tin, lead, arsenic, and antimony by a simple procedure. (auth)

#### 5108

AN AUTOMATIC DIFFERENTIAL POTENTIOMETRIC TITRATOR. H. V. Malmstadt and E. R. Fett (Univ. of Illinois, Urbana). *Anal. Chem.* **26**, 1348-51(1954) Aug.

A simple and inexpensive automatic differential potentiometric titrator is described which does not require any instrument adjustments prior to a titration. It is not necessary to know and set the end-point potential, because the electronic circuit computes the second derivative voltage of the ordinary potentiometric curve, and this voltage is ideally suited to trigger a relay system which turns the buret off at the inflection point of the titration. The instrument gives excellent precision and accuracy for the two oxidation-reduction systems used in testing the titrator. The titrator is applicable for automatic potentiometric titrations where the end-point potential is not known or changes with different titration conditions. (auth)

#### 5109

SPECTROPHOTOMETRIC DETERMINATION OF ARSENIC, PHOSPHORUS, AND SILICON IN THE PRESENCE OF EACH OTHER. Michael A. DeSesa and Lockhart B. Rogers (Massachusetts Inst. of Tech., Cambridge). *Anal. Chem.* **26**, 1381-3(1954) Aug.

A means of separating the heteropoly molybdo- acids of arsenic, silicon, and phosphorus by means of solvent extraction has been devised. The technique has been successfully tested for the spectrophotometric analysis of artificial mixtures of silicon and phosphorus and silicon and arsenic. While a mixture of all three elements was not analyzed, it seems entirely possible to determine arsenic, silicon, and phosphorus in one sample. The sum of all three heteropoly acids, which have identical spectra in the near ultraviolet region, could be determined on one sample. Then aliquots of this sample could be treated to remove phosphorus, and then arsenic, selectively, into isoamyl acetate in which medium these two elements can be individually determined. Finally the silica could be determined by correcting the absorbance in the aqueous phase for the contribution of arsenic and phosphorus. (auth)

#### 5110

URANIUM DETERMINATION BY USE OF THE PHOTODECOMPOSITION OF OXALIC ACID. Harold H. Paige, A. E. Taylor, and Robert B. Schneider (Idaho State Coll., Pocatello). *Science* **120**, 347-8(1954) Aug. 27.

A method for U determination by the photodecomposition of oxalic acid in the presence of uranyl ion proved effective on solutions of known U concentration in the range of  $10^{-4}$  g/l with a standard deviation of less than  $10^{-5}$  g/l. (C.H.)

#### 5111

APPLICATION OF THE CAPILLARY TUBE METHOD TO THE DETERMINATION OF RADIOCARBON. M. Reinharz

and G. Vanderhaeghe (Université Libre, Brussels, Belgium). *Nuovo cimento* (9) **12**, 243-9(1954) Aug. (In English)

An application of the capillary tube method to the determination of  $C^{14}$  in liquids or dissolved substances is described. The absolute sensitivity of the method has been found to be of the order of  $10^{-16}$  curie per cm tube length. The high sensitivity is useful when only very small amounts of a feebly active substance are available. (auth)

### DEUTERIUM AND DEUTERIUM COMPOUNDS

#### 5112

HEAVY WATER. Enrico Cerrai. *Energia Nucleare* No. 5, 96-103(1952) Dec. 20. (In Italian).

A review is given of the methods of separating heavy water. (J.S.R.)

### FLUORINE AND FLUORINE COMPOUNDS

#### 5113

REVIEW OF LITERATURE ON HEALTH HAZARDS OF FLUORINE AND ITS COMPOUNDS IN THE MINING AND ALLIED INDUSTRIES. S. J. Davenport and G. G. Morgis (U. S. Bureau of Mines, Washington, D. C.). *U. S. Bur. Mines Inform. Circ.* **7687**, June 1954, 55p.

### GRAPHITE

#### 5114

PARAMAGNETIC RESONANCE ABSORPTION IN GRAPHITE. G. R. Hennig, B. Smaller, and E. L. Yasaitis (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **95**, 1088-9(1954) Aug. 15.

#### 5115

LOW-TEMPERATURE THERMAL CONDUCTIVITY OF A CANADIAN NATURAL GRAPHITE. Alan W. Smith (North American Aviation, Downey, Calif.). *Phys. Rev.* **95**, 1095-6(1954) Aug. 15.

The anomalous nature of the temperature dependence of thermal conductivity and specific heat in low-temperature graphite is investigated. Temperature dependence of thermal conductivity as high as  $T^{2.3}$  has been found, whereas the specific heat is a function of  $T^3$ . Two explanations of the anomaly have been proposed, and the results of these experiments show that the effect is due to the presence of intergranular nongraphitic carbon. (K.S.)

### LABORATORIES AND EQUIPMENT

#### 5116

INDUSTRIAL DISTILLATION DEVELOPMENT AT HARWELL. NEW COLUMN PACKING DESIGNED AT THE A.E.R.E. *Atomics* **5**, 227-8(1954) Aug.

A new distillation column packing has recently been developed. It consists of a cellular structure made from  $1/8$  in. nominal mesh 20 to 24 s.w.g. expanded metal of  $1/16$  in. strand width. Experimental results show that the throughput is 200 to 250% of that of a bubble column with 18 in. plate spacing. Typical H.E.T.P. and pressure-drop data are given. (J.S.R.)

### RADIATION CHEMISTRY

#### 5117

Frick Chemical Lab., Princeton Univ.

[RESEARCH IN HIGH POLYMER CHEMISTRY—RATES OF INITIATION IN VINYL POLYMERIZATION]. TECHNICAL

REPORT NO. 2. THE INTERACTION OF BETA PARTICLES WITH ORGANIC LIQUIDS IN THE PRESENCE OF VINYL MONOMERS. 1. EXPERIMENTAL RESULTS.

W. H. Seitzer and A. V. Tobolsky. July 25, 1954. 12p. Contract DA-36-034-ORD-1496. (NP-5306)

Solutions of common organic solvents with vinyl monomers (either styrene or methyl methacrylate) have been exposed to a point source of beta particles, and the resulting rate of polymerization measured for several monomer concentrations. A very wide range of effectiveness of these solvents as radiosensitizers of polymerization was observed. (auth)

6118

RADIATION DAMAGE TO WATER. A. O. Allen (Brookhaven National Lab., Upton, N. Y.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 238-42(1954).

Water may decompose under radiation to give hydrogen and oxygen gases and small amounts of hydrogen peroxide. The amount of decomposition that water undergoes depends critically on the nature of the radiation, the kind and amount of dissolved materials present, and the temperature. Destruction of dissolved material may proceed to a greater extent than that of the water itself. The basic theory of these effects is briefly outlined. Engineering problems resulting from radiation chemical effects in water are discussed for various cases in which ordinary or heavy water is used in reactors as moderator, coolant, or shielding material. (auth)

6119

$\gamma$ -RAY-INDUCED OXIDATION OF AQUEOUS FORMIC ACID-OXYGEN SOLUTIONS. EFFECT OF pH. Edwin J. Hart (Argonne National Lab., Lemont, Ill.). J. Am. Chem. Soc. 76, 4198-4201(1954) Aug. 20.

Radiation yields of carbon dioxide, hydrogen, and hydrogen peroxide formed and oxygen reacted have been measured at 0.01M formic acid concentration over the pH range from 0.32 to 11.58. In the pH range above 3, molecular hydrogen and hydrogen peroxide are formed in equimolar amounts. Below this range of pH, an excess of hydrogen peroxide is formed. The results are interpreted in terms of number of water molecules dissociated in three primary reactions: (1)  $H_2O = H + OH$ , (2)  $H_2O = \frac{1}{2}H_2O_2 + \frac{1}{2}H_2$ , and (3)  $H_2O = H + \frac{1}{2}H_2O_2$ . Each of these three reactions is pH dependent. However, the total number of water molecules decomposed/100 ev is substantially constant in the pH range 0.32 to 11.58 and equals  $3.99 \pm 0.14$ . (auth)

6120

CHEMICAL CONSEQUENCES OF THE (n,  $\gamma$ ) REACTION ON PLATINUM COMPLEXES. B. C. Haldar (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc. 76, 4229-33(1954) Aug. 20.

Chemical consequences of the (n,  $\gamma$ ) reaction on platinum in complex compounds have been studied. The 18-hour platinum activity is found distributed in three different fractions: (1) the original compound or its derivative, (2) anions removable by ion-exchange resins IRA-400 and IR-4B, (3) cations and neutral molecules different from the original compound. The retention of activity in complexes with bidentate groups varies from 4 to 7% and is less than that in complexes with monodentate groups. From the retentivity values it appears that two or more bonds are broken in 93 to 96% of the cases. A detailed analysis of the products from slow neutron bombardment of  $[Pt(en)_2]Cl_2$  indicates that removable anion activity exists in three different forms—the first form (9%)

extractable into butyl acetate from 6N HCl without addition of stannous chloride, the second form (25%) extractable into butyl acetate only after addition of stannous chloride and the third form (15%) removable from solution only by anion exchange resins. It is observed that oxidation of bivalent to tetravalent platinum takes place as a result of the capture process. Of all the compounds studied in the present investigation, trans- $[Pt(en)_2Cl_2]Cl_2$  seems to be most suitable for the preparation of high specific activity radioplatinum by the (n,  $\gamma$ ) process. (auth)

6121

ELECTRON IRRADIATION OF POLYTHENE. A. C. Baskett (Imperial Chemical Industries, Ltd., Welwyn Garden City, Herts, England). Nature 174, 364-5(1954) Aug. 21.

The behavior of polythene when bombarded by 4-Mev electrons is reported. The development of a soluble fraction was observed when the extracted gel fraction of a lightly cross-linked polythene was irradiated which gave a positive demonstration of the occurrence of chain fission. The results suggested that the limiting soluble fraction lay between 2.4 and 2.8 per cent. Correspondingly, the ratio of main chain fissions to atoms cross-linked was found to be 0.18 to 0.20. From this it was possible to estimate with reasonable accuracy the gel fractions which would be obtained if no chain fission occurred. Results obtained from the calculation of the original molecular-weight distribution functions of a series of polythenes, with the exception of the low-molecular-weight tails, suggested that they have wide molecular-weight distributions. (J. A. G.)

RARE EARTHS AND RARE-EARTH COMPOUNDS

6122

OBSERVATIONS ON THE VAPOR TENSIONS OF THE METALS OF THE RARE EARTHS, THEIR SEPARATION AND PURIFICATION. Felix Trombe. Translated by Marie Louise Beeckmans from Bull. soc. chim. France, 1010-12(1953). 8p. (UCRL-Trans-191)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 8-1450.

SEPARATION PROCEDURES

6123

ON THE USE OF ION EXCHANGE MATERIALS IN ANALYTICAL CHEMISTRY. XI. EXPERIMENTS WITH SOLUTIONS CONTAINING BROMIDE, IODIDE, BROMATE, AND IODATE. Olof Samuelson. Translated from Iva 17, 5-9 (1946-47). 9p. (UCRL-Trans-177).

The separation of cations and anions has been studied using an organic cation exchanger. Solutions of bromide, iodide, chlorate, bromate, and iodate were percolated through a layer of  $H^+$  exchanger. Bromate and iodate were reduced, whereas it was possible to exchange the cation for hydrogen ion in the following cases: the bromides, iodides, and chlorates of Li, Na, K,  $NH_4$ , Mg, Ca, Sr, Ba, Zn, Mn(II), Ni, Co, Al, and Cr(III) and the bromides and chlorates of Fe(III). This makes it possible to determine the anions alkalimetrically in solutions containing these ions. The chromium salts can be separated even in hot solutions showing that the complexes in these solutions are much weaker than in solutions of sulphate or phosphate, which cannot be separated quantitatively. A polarographic determination of selenite was shown to be inaccurate or impossible in solutions containing  $Fe^{3+}$ ,  $Al^{3+}$ ,  $Co^{3+}$ ,  $Mn^{2+}$ , and  $Zn^{2+}$ . By means of an  $H^+$  exchanger it is possible to sepa-

rate these cations from selenite. After the separation the selenite can be determined polarographically. (auth)

#### 6124

PULSE COLUMN VARIABLES. SOLVENT EXTRACTION OF URANYL NITRATE WITH TRIBUTYL PHOSPHATE IN A 3-IN.-DIAM. PULSE COLUMN. G. Sege and F. W. Woodfield (Hanford Works, Richland, Washington). *Chem. Eng. Progr.* 50, 396-402(1954) Aug.

The general performance characteristics of sieve-plate, liquid-liquid extraction columns in which the contents are pulsed through the plates are illustrated with data on the solvent extraction of uranyl nitrate with tributyl phosphate in a 3-in.-diam. pulse column. Effects of operating conditions and sieve-plate section design on solvent-extraction effectiveness and capacity are discussed, and the application of the data to columns of larger diameter is indicated. For chemical systems reported a sieve-plate section design termed a "standard cartridge," composed of stainless steel plates spaced 2 in. apart and perforated with  $\frac{1}{8}$ -in. holes to yield 23% free area, has been found a useful compromise between the conflicting objectives of high throughput capacity and near-optimum extraction effectiveness. With such a column design, extraction effectiveness generally improves as either the pulse amplitude or frequency is increased, optimum performance typically occurring slightly below an amplitude-frequency product which results in flooding the column because of excessive emulsification. The height of a transfer unit or height equivalent to a theoretical stage for pulse columns operating at near-optimum conditions frequently is approximately one third as high as for a conventional packed extraction column. Throughput capacities of the two types of contactors are comparable. (auth)

#### 6125

LIQUID-METAL-FUEL REACTOR PROCESSING LOOPS. C. Raseman and J. Weisman (Brookhaven National Lab., Upton, N. Y.). *NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12*, 153-72(1954).

Laboratory and pilot-plant experiments have been conducted to test the feasibility of extracting fission products from a molten-metal fuel with fused salts. Two stainless steel loops, in which bismuth-uranium solution has been circulated by means of electromagnetic pumps, have been built and operated. Satisfactory techniques for handling molten bismuth-uranium and salt on the pilot-plant scale have been developed. Test results indicate that under isothermal conditions type 347 stainless steel is satisfactory, from an engineering standpoint, as a container material for the uranium-bismuth solution. However, under non-isothermal conditions, and without the presence of inhibitors, mass-transfer corrosion occurs. Type 347 stainless steel appears to contain the molten lithium chloride-potassium chloride eutectic with little corrosion taking place. A molten-metal-circulation system is being built for operation at an experimental hole of the Brookhaven Reactor. The fission products generated in the interior section of the loop will be processed in an external section. The removal of gaseous fission products by helium sweeping or vacuum will be investigated along with salt extraction of the non-volatile rare-earth fission products. (auth)

#### 6126

ION EXCHANGE IN MIXED SOLVENTS. O. D. Bonner and Jane C. Moorefield (Univ. of South Carolina, Columbia). *J. Phys. Chem.* 58, 555-7(1954) July.

Equilibrium studies of the silver-hydrogen system on

Dowex 50 were made in ethanol-water and dioxane-water media. The characteristic solvent uptake of the pure silver and hydrogen resins and the composition of the imbibed solvent were determined. The over-all selectivity of the resin increased by the addition of an organic solvent. The swollen volume of the hydrogen resin remains relatively constant if water is present in the solvent phase. The presence of organic solvent, however, appeared to shrink the silver resin. (auth)

#### 6127

SEPARATION OF IODIDE, BROMIDE, AND CHLORIDE FROM ONE ANOTHER AND THEIR SUBSEQUENT DETERMINATION. Thomas J. Murphy, W. Stanley Clabaugh, and Raleigh Gilchrist (National Bureau of Standards, Washington 25, D. C.). *J. Research Natl. Bur. Standards* 53, 13-18(1954) July.

A method is described for separating iodide, bromide, and chloride from one another. First, the iodide ion is oxidized to elementary iodine by hydrogen peroxide in weakly acid solution and the iodine removed by distillation. Next, bromide is oxidized to bromine without affecting the chloride ion by use of a controlled concentration of nitric acid as oxidizing agent. After removal of bromine by distillation chloride remains in the residual solution. Determination of the individual halides depends on the quantity of each. If in trace amounts, a turbidimetric method is used; if in larger amounts, potentiometric titration with silver nitrate is used. A description of the apparatus used is also given. (auth)

### TRACER APPLICATIONS

#### 6128

USE OF OXYGEN ISOTOPE EFFECTS IN THE STUDY OF HYDRATION OF IONS. Henry Taube (Univ. of Chicago). *J. Phys. Chem.* 58, 523-8(1954) July.

The work of John P. Hunt, Aaron C. Rutenberg, Robert A. Plane, and Harold M. Feder on the hydration of ions using isotope effects for oxygen as a tool is reviewed. An explicit goal in the research is to characterize the species which result on the interaction of the solvent water and the ions contained therein, in being supposed that for some ions at least, a sharp distinction between water in the first sphere and water in outer spheres will be possible. The most direct attack is to use a kinetic method, depending on the difference in rate of exchange with solvent which may exist for water held in the first sphere as against water contained in outer spheres. A less direct approach but one which can be given great power when developed is an equilibrium method, the measurement of the effect that salts exert on the activity ratio of  $\text{H}_2\text{O}^{18}$  compared to  $\text{H}_2\text{O}^{16}$  in the liquid. The results of this study are presented and discussed. (auth)

### TRANSURANIC ELEMENTS AND COMPOUNDS

#### 6129

THE SEPARATION AND PURIFICATION OF AMERICIUM-241 AND THE ABSORPTION SPECTRA OF TERVALENT AND QUINQUEVALENT AMERICIUM SOLUTIONS. G. R. Hall and P. D. Herniman (Atomic Energy Research Establishment, Harwell, Berks, England). *J. Chem. Soc.*, 2214-21(1954) July.

The separation and purification of  $\text{Am}^{241}$  (25 mg), produced by the  $\beta$  decay of  $\text{Pu}^{241}$  in plutonium containing small amounts of the latter isotope, is described. The absorption spectra of americium(III) in perchloric acid and in hydro-

chloric acid have been measured. The narrow 504-m $\mu$  peak does not obey either Beer's or Lambert's law; the 814-m $\mu$  peak obeys both. By following changes in the absorption spectra the disproportionation and self-reduction of americium(V) in hydrochloric acid have been observed. Self-reduction is caused by reducing materials produced in solution by  $\alpha$ -particle bombardment. In low acid concentrations only self-reduction occurs, but in more concentrated acid solutions disproportionation predominates. (auth)

## URANIUM AND URANYL COMPOUNDS

6130

Argonne National Lab.

THE HEATS OF FORMATION OF URANIUM HYDRIDE, URANIUM DEUTERIDE, AND URANIUM TRITIDE AT 25°C. B. M. Abraham and H. E. Flotow. June 1954. 11p. Contract W-31-109-eng-38. (ANL-5295)

The heats of formation of uranium hydride, deuteride, and tritide were measured at 25°C by reacting finely divided uranium with hydrogen gas in an adiabatic calorimeter. It was found that the heat of formation became progressively more negative as deuterium and then tritium were substituted for hydrogen. The values obtained for UH<sub>3</sub>, UD<sub>3</sub>, and UT<sub>3</sub> are  $-30,352 \pm 30$ ,  $-31,021 \pm 30$ , and  $-31,141 \pm 50$  cal/mole, respectively. (auth)

6131

INVESTIGATIONS ON THE CO-ORDINATIVE POWER OF URANYL. PART I. THE PREPARATION AND PROPERTIES OF URANYL COMPLEXES OF CERTAIN  $\beta$ -DIKETONES. L. Sacconi and G. Giannoni (Univ. of Firenze, Florence, Italy). J. Chem. Soc., 2368-72 (1954) July.

Uranyl acetate and nitrate with some  $\beta$ -diketones yield a series of complexes of different composition. The constitution of the complexes, their solubilities, and their behavior toward different reagents show that uranium(VI), bound to six oxygen atoms, is co-ordinatively unsaturated. The properties of some water-insoluble and undissociated nitrate-complexes afford conclusive evidence of the existence of covalent bonds between uranyl and nitrate ions. A polymer complex of benzoylnicotinoylmethane is believed to be an instance of 8-coordination around uranium(VI). (auth)

6132

ELECTROLYTIC PREPARATION OF URANIUM FROM A FLUORIDE BATH. S. K. Kantan, N. Shreenivasan, and G. S. Tendolkar (Atomic Energy Commission, Govt. of India). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 63-6 (1954).

Uranium metal was prepared electrolytically from a fused-salt bath containing potassium uranium fluoride or uranium tetrafluoride. Potassium uranium fluoride was prepared by the photochemical reduction of uranyl nitrate in the presence of alcohol. Uranium tetrafluoride was prepared by the hydrofluorination of the uranium dioxide made by the reduction of uranium peroxide with hydrogen. The tetrafluoride was first dried in air, and the final traces of moisture were removed by drying at 400°C in a stream of hydrogen and hydrogen fluoride. Electrolysis of the fluoride is carried out from a fused bath of calcium chloride and sodium chloride contained in a graphite crucible which also serves as the anode. A strip of molybdenum serves as the cathode. Conditions studied include current density of 50 to 400 amp/dm<sup>2</sup>, and temperature of 725 to 900°C. The relative merits of the double fluoride and tetrafluoride are discussed. (auth)

6133

THE SYSTEM URANYL NITRATE-DIETHYL ETHER-WATER. EXTRACTION BY WATER IN SPRAY AND PACKED COLUMNS FROM URANYL NITRATE-ETHER SOLUTIONS. Luis G. Jodra, A. P. Luina, and A. Oroz (Junta de Energía Nuclear, Madrid, Spain). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 127-43 (1954).

The equilibrium distribution of uranyl nitrate between water and diethyl ether was determined at 25°C. The ternary diagram for liquid solutions is also given. Comparison with previous data at other temperatures shows that temperature influences the distribution very slightly. Correlations of the tie lines are also given. Uranium was determined by reducing the sulfuric solution with a cadmium column and titrating with potassium permanganate. Water was determined with Fischer reagent in a dead-point apparatus. Data for values of transfer coefficients, heat transfer unit, and heat equivalent to a theoretical plate in spray and packed columns are given for both continuous phases. Correlations for the different factors are also given. (auth)

6134

EFFECTS OF DESTRUCTIVE DISTILLATION ON THE URANIUM ASSOCIATED WITH SELECTED NATURALLY OCCURRING CARBONACEOUS SUBSTANCES. Irving A. Breger, Robert Meyrowitz, and Maurice Deul (U. S. Geological Survey, Washington, D. C.). Science 120, 310-12 (1954) Aug. 20.

Samples of Chattanooga shale, subbituminous coal, coal from Chattanooga shale, and Swedish kalm were subjected to dry distillation in small-scale glass apparatus. Uranium balances in the original samples and in the chars are tabulated. It is concluded that destructive distillation of these carbonaceous substances results in no appreciable volatilization of U. (A.G.W.)

## ENGINEERING

6135

Southwest Research Inst.

DEVELOPMENT OF POLYNUCLEAR AROMATIC COMPOUNDS FOR USE AS HIGH-TEMPERATURE LUBRICANTS AND RELATED MATERIALS. QUARTERLY REPORT NO. 2 [FOR] NOVEMBER 1, 1953-FEBRUARY 1, 1954. 34p. Contract AF 33(616)-276, Technical Report No. 6. (NP-5258)

(For preceding period see NP-5132.)

6136

Petroleum Refining Lab., Penna. State Coll. School of Chemistry and Physics

FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. FINAL REPORT FOR OCTOBER 1952 THROUGH SEPTEMBER 1953. Dec. 1, 1953. 243p. Contract AF33(038)-18193. (PRL-5.8).

6137

BEARINGS INSENSITIVE TO SHOCK. W. Frossel. Translated from Motortech. Z. 14, 179-80 (1953). 4p. (AERE-Trans-11/3/5/433)

6138

SELF-CLEANING AIR FILTER. DETAILS OF THE HERSEY REVERSE-JET FILTER. Knowlton J. Caplan (St. Louis, Mo.). Chem. Eng. Progr. 50, 409-14 (1954) Aug.

Design and performance of a Hersey filter, consisting of a cylindrical tube, or bag, of filter material such as dense wool felt which is slowly traversed by a slotted tube that contacts and indents the filter medium and blows a high-velocity jet of gas through the medium in direction reverse to that of the normal gas flow, are described. The filter usually provides 99.9% or better collection efficiency on a weight basis, has proved of high efficiency for vaporized silica of  $0.6 \mu$  mass median size, and is presumed to be efficient in the submicron range. However, it is suitable only for temperatures of 190 to 200°F and mild acid or alkaline conditions. (J.A.G.)

6139

## SIMPLE CONTROLLER FOR A PLATINUM FURNACE.

Myron B. Reynolds (Knolls Atomic Power Lab., Schenectady, N. Y.). *Rev. Sci. Instr.* 25, 838-9(1954) Aug.

A simple floating-type controller for a Pt resistance furnace is described. (L.T.W.)

## HEAT TRANSFER AND FLUID FLOW

6140

Stanford Univ.

A SUMMARY OF BASIC HEAT TRANSFER AND FLOW FRICTION DESIGN DATA FOR PLAIN PLATE-FIN HEAT EXCHANGER SURFACES. W. M. Kays and S. H. Clark. Aug. 15, 1953. 133p. Contract N6-onr-251, T. O. 6, Technical Report No. 17. (AD-16407)

Data on four plain-fin surfaces are presented, and the entire investigation of plain-fin surfaces is summarized with definite recommendations made for the design of heat exchangers employing such surfaces. The Reynolds number range of interest for gas flow in compact plain-fin surfaces extends from about 500 to 15,000. The test data include both heat transfer and flow friction performance. The bulk of the heat transfer test results were obtained with a constant wall temperature. It was found that for turbulent flow both the heat transfer and flow friction performance is relatively independent of flow tube cross section shape if Reynolds number is based on hydraulic diameter. In laminar flow tube shape is of great importance, and the ratio of tube length to hydraulic diameter is of importance for laminar and turbulent flow. An analysis is presented for the limiting conditions of laminar flow in cylindrical tubes of rectangular cross section with any aspect ratio, corresponding to the conditions of fully established laminar flow velocity and temperature profiles. The test results indicate that solutions for laminar flow in rectangular tubes are applicable to production-fabricated plate-fin surfaces, providing that the departure from a true rectangle is not too great. Curvature at the fin roots, of the character generally obtained when the surface is manufactured of folded sheet material brazed between plates, does not involve a significant departure from the rectangular tube idealization. (auth)

6141

Stanford Univ.

PIN-FIN HEAT EXCHANGER SURFACES. W. M. Kays. Aug. 30, 1953. 55p. Contract N6-ONR-251, T. O. 6, Technical Report No. 19. (AD-17874)

Plate-fin heat transfer surfaces in which the fins are small diameter circular pins, in contrast to fins in sheet form, are of interest in gas-flow heat exchanger applications because of the extremely high heat transfer conductances obtainable along with high fin effectiveness. Pre-

viously available heat transfer and flow friction design data for such surfaces are summarized, and new data recently obtained are presented. A number of problems encountered in the development of these surfaces are discussed, including a serious pin vibration problem, and a tendency for the flow to become completely laminar if the pins are in-line and too closely spaced. All of the pin-fin surfaces considered have in-line pin arrangements, and it is concluded that a staggered pin arrangement will alleviate some of the undesirable features of the in-line arrangement. A heat exchanger design study is included to demonstrate that, despite the high friction factors characteristic of pin-fin surfaces, it is possible to design more compact heat exchangers with these surfaces than with comparable plate-fin surfaces in which the fins are of continuous or louvered sheet form. (auth)

6142

Massachusetts Inst. of Tech.

## HEAT, MASS, AND MOMENTUM TRANSFER FOR FLOW OVER A FLAT PLATE WITH BLOWING OR SUCTION.

H. S. Mickley, R. C. Ross, A. L. Squyers, and W. E. Stewart. Feb. 4, 1953. 151p. (NACA-TN-3208)

The effect on the boundary layer of sucking or blowing air through a porous flat plate into or out of a main air stream flowing parallel to the plate was studied theoretically and experimentally. Laminar-boundary-layer theory was used to calculate velocity, temperature, and concentration profiles and friction, heat, and mass transfer coefficients as a function of the Prandtl or Schmidt modulus and the mass transfer rate for the case of laminar, zero Euler number flow with a mass transfer rate varying as  $1/\sqrt{x}$ , where  $x$  is the axial distance from the leading edge of the plate. For turbulent flow film theory was expanded to provide a prediction of the effect of mass transfer on the friction, heat, and mass transfer coefficients. Experimental measurements of velocity and temperature profiles and of friction and heat transfer coefficients were carried out over a range of flow conditions. Main-stream velocity was varied between 5 and 60 fps, a length Reynolds number range of 6,500 to 3,300,000 was covered, and the mass transfer velocity ranged from  $-0.3$  to  $0.26$  fps and included constant axial mass transfer velocity and  $1/\sqrt{x}$  and  $1/x^{0.2}$  distributions. One test was made with a positive Euler number; all other results apply to zero Euler number flow. (auth)

6143

Langley Aeronautical Lab., NACA

## TURBULENT-HEAT-TRANSFER MEASUREMENTS AT A MACH NUMBER OF 3.03. Maurice J. Brevoort and Bernard Rashis. June 24, 1954. 21p. (NACA-TN-3303)

A three-dimensional axially symmetric plug nozzle was used to obtain flat-plate data on turbulent-heat-transfer coefficients and recovery factors. The test results are for Mach number 3.03 and for a Reynolds number range of  $5.6 \times 10^6$  to  $6.5 \times 10^7$ . The heat-transfer-coefficient results are in good agreement with theoretical analyses, and the recovery-factor results are in good agreement with extrapolations of lower Reynolds number data. (NACA abst.)

6144

Delaware Univ.

## ENGINEERING PROPERTIES OF NON-NEWTONIAN FLUIDS IN MIXING AND HEAT TRANSFER. TECHNICAL REPORT NO. 1. FLOW OF NON-NEWTONIAN FLUIDS-CORRELATION FOR THE LAMINAR, TRANSITION AND

**TURBULENT FLOW REGIONS.** A. B. Metzner and J. C. Reed. Aug. 20, 1954. 28p. Contract DA-36-034-ORD-1495. (NP-5307)

A clear physical understanding of the mechanics of non-Newtonian flow was a necessary prerequisite to an orderly development of mixing and heat transfer theory. As a result of this fluid mechanics work, all available data on flow of non-Newtonian fluids in pipes have been correlated on the conventional friction factor—Reynolds number plot for Newtonian fluids. This correlation, theoretically rigorous in the laminar flow region, was tested with data on 16 different non-Newtonian materials covering the  $2.1 \times 10^3$  range of Reynolds numbers from  $6.0 \times 10^{-5}$  to  $1.3 \times 10^5$ . Pipe diameters varied from  $\frac{1}{8}$  to 12 in. As the correlation does not depend on the type of fluid encountered, it may be used with Newtonian and non-Newtonian fluids alike. (auth)

6145

**ON A LAW OF THE TURBULENT MOTION OF A FLUID IN SMOOTH PIPES.** A. D. Al'tshul'. Translated by M. D. Friedman from Doklady Akad. Nauk S.S.S.R. 75, 617-20(1950). 10p. (AEC-tr-959)

6146

**THE REFINEMENT OF THE CALCULATION OF THE HEAT EXCHANGE COEFFICIENT BETWEEN A GAS AND SUSPENDED PARTICLES USING THE HEAT FILM METHOD.** L. I. Kudryashev. Translated by M. D. Friedman from Izvest. Akad. Nauk S.S.S.R. Otdel Tekh. Nauk, No. 11, 1620-6(1949). 10p. (AEC-tr-981)

## PUMPS

6147

Atomic Energy Research Establishment, Harwell, Berks (England)

**HOMOPOLAR GENERATORS AND LIQUID METAL BRUSHES. A BIBLIOGRAPHY.** M. Greenhill. 1954. 6p. (AERE-Inf/Bib-92)

This bibliography on homopolar generators and liquid metal brushes includes 64 references taken from the Harwell report indexes, Nuclear Science Abstr. up to volume 7(1953), Science Abstr. B up to volume 56(1953), Eng. Index 1939 to 1952, and Ind. Arts Index 1947 to 1952. (J.A.G.)

6148

**SIMPLE SAFETY DEVICE FOR Hg DIFFUSION PUMPS.** W. Spindel and E. H. McLaren (New York State Coll. for Teachers, Albany). Rev. Sci. Instr. 25, 830(1954) Aug.

An accident which may occur in vacuum systems, often with serious consequences, is the shattering of a Dewar flask and loss of coolant surrounding the cold trap. This permits the distillation of appreciable quantities of Hg into regions of a vacuum system which contain metal parts attackable by Hg. A simple safety device is described to prevent distillation of the Hg into the vacuum system. (L.T.W.)

## WASTE DISPOSAL

6149

**PROCESSES FOR HIGH-LEVEL WASTE DISPOSAL.** Bernard Manowitz and L. P. Hatch (Brookhaven National Lab., Upton, N. Y.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 144-52(1954).

The high-level aqueous waste stream from a typical solvent extraction separation process can have the following composition: (1) fission products, (2) oxidant, (3) inor-

ganic nitrates (salting in agents, (4) uranyl nitrate (loss during extraction), (5) nitric acid, (6) soluble impurities in the initial uranium, (7) corrosion products, and (8) traces of the solvent and of radiation breakdown products from the solvent. This paper discusses two possible alternate methods of off-site waste disposal. One method involves evaporating the waste to dryness and fusing it into a melt—all within disposable containers. The fact that all variations of the waste streams can be made to contain a high concentration of sodium nitrate permits one to make a melt of the nitrate in which all the other melts are incorporated as insoluble oxides. Pilot-plant-scale equipment is described in which the physical and chemical feasibility of the process has been demonstrated successfully. The radiochemical features of the problem are still under investigation. The other method involves the adsorption of fission product ions on montmorillonite clay and the fixation of the absorbed ions by heating the clay to high temperature. The capacity of the clay is found to be about 1 milliequivalent/g for cation exchange, and a high degree of fixation has been demonstrated. Investigations are now centered in the problem of removing nitric acid from the raw waste solutions by the use of anion exchange resins or permionic membranes. Problems associated with the preparation of clay beds which permit free flow of waste solutions through them have been solved, and equipment is being assembled for a pilot plant for testing the entire clay process on a large scale. (auth)

## MINERALOGY, METALLURGY, AND CERAMICS

6150

Massachusetts Inst. of Tech.

**THE ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS.** July 31, 1954. 39p. Contract AT(30-1)-956. (NYO-6260; MITS-24)

The adsorption of the potential-determining ions  $\text{HS}^-$ ,  $\text{Ag}^+$ , and  $\text{S}^{2-}$  on  $\text{Ag}_2\text{S}$  is being measured. Adsorption studies of  $\text{Ag}^+$  and  $\text{I}^-$  on  $\text{AgI}$  in the presence and absence of lauric acid were made at pH 5 and higher. The adsorption and desorption of Cu on sphalerite in the presence of Cu complexing agents were studied. The dissolution of  $\text{CuS}$  by  $\text{NaCN}$  was studied. No conclusive results have been obtained on the adsorption of  $\text{Na}^+$  on quartz. Desiccate-treated glass filters will be used to control the moisture content in the study of  $\text{Na}^+$  adsorption on quartz. The study of the adsorption of hexanethiol on Ag at the Ag-air and Ag-liquid interface has continued. Streaming potential measurements were made on  $-35+48$  and  $-48+65$  mesh particles of sapphire in solutions of  $\text{HCl}$  and  $\text{NaCl}$ . Steady state grinding experiments were carried out on a number of different feed materials with a vibratory ball mill. Attempts were made with a centrifugal elutriator to make size separations at approximately 5, 3, 1, and 0.5 microns. The pH effect in grinding quartz was studied. A turbidimetric method for determining relative specific surfaces is being studied. (For preceding period see NYO-6258.) (J.S.R.)

## CERAMICS AND REFRACTORIES

6151

Massachusetts Inst. of Tech.

**THE MEASUREMENT OF THERMAL CONDUCTIVITY OF**

**REFRACTORY MATERIALS.** W. D. Kingery and F. H. Norton. June 30, 1954. 16p. Contract AT(30-1)-960. (NYO-6444).

Theoretical relationships and experimental data for a number of oxide materials have been compared over a wide temperature range. Deviations from the basic  $1/T$  relationship are caused by radiant energy transmission, a high Debye temperature, a low mean-free path of the thermo-elastic waves, porosity, and in a few cases electronic conductivity. Extrapolation of thermal conductivity data to high temperatures is not reliable. (auth)

### 6152

Alabama Univ.

**THERMAL EXPANSION OF SOME GLASSES IN THE SYSTEM  $\text{Li}_2\text{O}-\text{CaO}-\text{SiO}_2$ .** J. H. Handwerk and T. N. McVay. July 16, 1954. 24p. Contract AT(40-1)-1080. (ORO-126).

The thermal expansions and devitrification temperatures of some glasses in the system  $\text{Li}_2\text{O}-\text{CaO}-\text{SiO}_2$  were investigated. Coefficient of expansion factors for lithia, soda, calcia, and silica were calculated and found to be in fair agreement with the more generally accepted expansion factors as found in the literature. The effect of fluorine in glasses in this system was also studied, and fluorine, within the limits of this investigation, was found to have very little effect on the thermal expansion of these glasses. However, an increase in fluorine was found to lower the interferometer softening point of the glasses approximately ten degrees centigrade for each one percent by weight of fluorine added. (auth)

### 6153

**HIGH-TEMPERATURE TESTING TECHNIQUES FOR BRITTLE REFRACTORY MATERIALS.** James J. Gangler (Lewis Flight Propulsion Lab., Cleveland, Ohio). *J. Am. Ceram. Soc.* 37, 439-44(1954) Sept.

The evaluation of brittle refractory materials calls for special techniques that are different from those normally used for ductile materials. Techniques were developed to evaluate brittle materials as turbine blades in jet engines and in creep, stress rupture, and thermal shock. The type of equipment and the procedure for creep and stress-rupture testing are described. A parameter is given by which the thermal-shock resistance of brittle materials is related to their physical properties. A simple apparatus was devised to verify experimentally conclusions given by this parameter. Another apparatus is described that simulates the thermal shock conditions encountered in a jet engine. The final testing of materials in a jet engine is described. (auth)

## CORROSION

### 6154

Naval Engineering Experiment Station, Annapolis  
**PRECIPITATION HARDENING CORROSION RESISTANT STEELS.** W. Lee Williams. Sept. 22, 1949. 30p. (EES-C-3645).

This report concerns three types of corrosion resistant steels which can be hardened by precipitation. The steels are modifications of the 18 Cr-8 Ni type, the compositions of which are adjusted to produce substantial austenite decomposition and precipitation of an alloying element soluble in the parent austenite. The hardening treatments are performed at moderately low temperatures (around 1000°F). High mechanical properties are obtainable. The endurance properties in air and the corrosion fatigue properties in

brackish estuary water are reported. Corrosion in sea water occurs in the same manner as that experienced by ordinary 18-8 compositions. (auth)

### 6155

Armour Research Foundation

**CORROSION PREVENTIVE ADDITIVES.** E. J. Schwoegler and L. U. Berman. Feb. 1953. 121p. Contract AF 33(038)-9202. (WADC-TR-53-16(pt.1); AD-8961)

New corrosion inhibitors to supplement or replace petroleum sulfonates are investigated. A study of petroleum sulfonates was made to determine the nature of the compounds showing corrosion inhibition. Separation of a commercial sodium petroleum sulfonate into certain components was effected by chromatography. Both Attapulgus clay and paper were successful in fractionating the petroleum sulfonates so that physical measurements could be made on the fractions. From these studies, it appears that sodium petroleum sulfonates are alkyl benzene derivatives with the alkyl group in the para position to the sulfonic acid group. A large number of commercially available organic compounds were evaluated by the NRL Static Water Drop Test and by use of a galvanic couple system at 95% relative humidity at 100°F. Several good inhibitors were found by the Static Water Drop Test method. The test presently used, employing the galvanic couple, is not as efficient for screening as the Static Drop Test method. In spite of this, certain general information concerning the type of organic compounds which will inhibit galvanic corrosion with the system used has been obtained. Guided by data obtained from these evaluation tests, information obtained from the chromatography and information gained from experience in the field, a large number of organic compounds were synthesized having corrosion inhibiting properties. These included glyoxalidines, alkyl aryl sodium sulfonates, amine salts of 2-ethylhexoic, oleic, nicotinic, pelargonic, linoleic, and dodecylbenzenesulfonic acids. (auth)

### 6156

**CORROSION OF ZIRCONIUM IN HIGH-TEMPERATURE WATER.** D. E. Thomas (Westinghouse Atomic Power Division, Pittsburgh, Penna.). *NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12*, 16-22(1954).

The corrosion of iodide-process zirconium in high-temperature water is reviewed. The kinetics of the corrosion reaction are given as a function of temperature and are characterized by a more or less protracted initial period of slow corrosion followed by a period of more rapid corrosion. The effects of impurities, surface preparation, mechanical deformation, metallurgical structure, and water purity are discussed. (auth)

### 6157

**CORROSION INHIBITORS AND POLAROGRAPHIC MAXIMA.** Harry C. Gatos (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.) *J. Electrochem. Soc.* 101, 433-41(1954) Sept.

Electrical polarization phenomena occurring in corrosion and polarographic processes are compared, and certain similarities are pointed out. On this basis, results of polarographic studies of a number of corrosion inhibitors are presented, particularly for the iron-sulfuric acid system. It is found that these inhibitors considerably suppress one or more of the oxygen, lead, or nickel polarographic maxima. The maxima-suppressing effectiveness of compounds known to inhibit corrosion by adsorption is a function of concentration resembling gas adsorption isotherms. Furthermore,

certain inhibitors which function by either anodic or cathodic polarization are also effective in suppressing either anodic or cathodic maxima. Some general inhibitors are general maxima suppressors as well. Polarography is suggested as a valuable tool in corrosion inhibitor studies. (auth)

#### 6158

**CORROSION PROPERTIES OF TITANIUM IN MARINE ENVIRONMENTS.** H. B. Bomberger, P. J. Cambourelis, and G. E. Hutchinson (Rem-Cru Titanium, Inc., Midland, Penna.). *J. Electrochem. Soc.* 101, 442-7(1954) Sept.

Data are presented on the behavior of commercially pure titanium and several common structural metals exposed up to five years at Kure Beach, N. C. Tests include exposures to the atmosphere, quiet and flowing sea water, jet impingement, stress corrosion, and galvanic couples. These tests indicate that titanium is unaffected by marine environments. (auth)

#### 6159

**PITTING CORROSION CHARACTERISTICS OF ALUMINUM. INFLUENCE OF IRON AND SILICON.** P. M. Aziz and Hugh P. Godard (Aluminium Labs., Ltd., Kingston, Ontario, Canada). *Corrosion* 10, 269-72(1954) Sept. (cf. NSA 6-6050).

Iron and silicon in amounts from 0.05 to 0.7%, alone and in various combinations, were added to commercial purity (99.75% Al) and super purity (>99.99% Al) aluminum. The addition of iron at any level increases the pitting probability of super purity aluminum whereas no significant increase occurs for the commercial purity aluminum. The addition of silicon to super purity aluminum in amounts of 0.3% and greater increases the pitting probability, whereas no significant increase occurs for commercial purity aluminum. The probability of pitting of commercial purity aluminum is 2.5 times that of the super purity aluminum at corresponding iron and silicon levels. The addition of iron and/or silicon increases the rate of pitting of super purity aluminum but has little effect on the rate of pitting of commercial purity aluminum. (auth)

#### 6160

**OXIDATION OF PLAIN, ALLOYED AND DUCTILE IRONS AT 1300 DEGREES F.** J. A. Cameron (Elliott Company, Jeannette, Penna.). *Corrosion* 10, 295-8(1954) Sept.

Oxidation tests of up to 4000 hr duration at 1300° F were made on ordinary flake graphite gray irons, ductile iron, and on highly alloyed cast iron having both flake and spheroidal graphite. It is concluded that ductile irons possess resistance to oxidation markedly better than that of flake graphite irons. In highly alloyed irons the difference is less pronounced at this temperature. Specimens were exposed in atmospheric tempering furnaces equipped with fans for circulation of air. (auth)

### GEOLOGY AND MINERALOGY

#### 6161

Department of Mines and Technical Surveys. Mines Branch (Canada)

**RADIOACTIVITY DIVISION GENERAL PROGRESS REPORT [FOR] APRIL-JUNE 1954.** 19p. (GPR-2/54)

The status of the work on ore dressing and extractive metallurgy, chemical and radiometric assays of ores during the period, chemical analyses and methods, tracer experiments and radiation detection instruments, mineralogical investigations, and reports covering investigations on ore samples from private companies and individuals is

briefly outlined. No technical data are reported. (For preceding period see GPR-1/54) (J.E.D.)

### METALS AND METALLURGY

#### 6162

Massachusetts Inst. of Tech.

**RESEARCH AND DEVELOPMENT OF MOLYBDENUM WELDING. PROGRESS REPORT NO. 1 FOR THE PERIOD JANUARY 1 TO MARCH 31, 1953.** John Wulff. 5p. Contract AF33(616)-361. (AD-10781)

#### 6163

Smith, A. O., Corp.

**EFFECT OF WELDING VARIABLES UPON FLASH WELD QUALITY.** K. Davey. Feb. 16, 1953. 44p. (AD-12158; AD-193)

#### 6164

Armour Research Foundation

**STUDY OF EFFECTS OF ALLOYING ELEMENTS ON THE WELDABILITY OF TITANIUM SHEET. FIRST QUARTERLY REPORT.** H. E. Meyer and John M. Parks. Dec. 17, 1952. 22p. Contract AF-33(616)-206. (AD-14452)

#### 6165

Ryan Aeronautical Co.

**TITANIUM FORMABILITY AND WELDING CHARACTERISTICS. NINTH MONTHLY PROGRESS REPORT. B.** Holland and Hugh B. Hix. July 10, 1953. 23p. Contract AF 33(600) 22169. (AD-17366; G-17-54)

Several groups of spot welds were compared on the basis of shear strength and macroscopic examination of the weld nugget to determine the effect of various types of electrode material on the quality of Ti spot welds. Embrittlement testing was continued by exposing samples to synthetic exhaust gas atmosphere (85% N<sub>2</sub>, 11.5% CO<sub>2</sub>, and 3.5% O<sub>2</sub>) at 1000, 1200, 1300, and 1400°F. Oxide scaling is reported at 1400°F. Results of bend tests and hydropress testing of cold-formed Ti specimens are given. (J.A.G.)

#### 6166

Rock Island Arsenal Lab.

**ARTILLERY MATERIEL, LIGHTWEIGHT TRAILS. REPORT NO. 2. FABRICATION OF TITANIUM TRAILS FOR THE 76 m/m GUN CARRIAGE, T66.** J. K. McDowell and Warren E. Peterson. Sept. 9, 1953. 28p. (AD-21917)

Machining, forming, and welding operations and procedures used in the fabrication of Ti trails for a 76-mm gun carriage, T66, are presented and compared with those for other light-weight metals. Results indicated that Ti is much more difficult to machine than low alloy of C steels and that formability of commercially pure Ti sheet is poorer than plain C or low alloy steel and compares favorably with stainless steel. Nonuniformity in sheet quality, scratches, and nicks affected the forming characteristics. The commercially pure Ti sheet can be satisfactorily fabricated into weldments if the proper welding procedures are used. The most important factor of the welding procedure was found to be adequate inert gas coverage of heated surface areas. (J.A.G.)

#### 6167

Institute for the Study of Metals, Univ. of Chicago  
**SURFACE REACTIONS IN METALS AND ALLOYS. QUARTERLY PROGRESS REPORT [FOR] AUGUST 1, 1953 TO NOVEMBER 30, 1953.** Norman H. Nachtrieb, Leroy G. Schulz, and Robert Gomer. 9p. Contract AF 33(616)-2090. (AD-25057)

**6166**

Battelle Memorial Inst.

HIGH-TEMPERATURE BRAZING OF NICHROME V. H. A. Saller, J. T. Stacy, and H. L. Klebanow. Aug. 2, 1954. 26p. Contract W-7405-eng-92. (BMI-933)

The tensile strengths and ductilities of Nichrome V joints brazed with a palladium-nickel-chromium brazing alloy (GE 76) were determined at room temperature and at 1200, 1650, and 1800°F. The tensile strengths and ductilities of the brazing alloy were obtained at the same temperatures. At 1650°F and above, the brazing alloy was stronger than the Nichrome V, whereas, at 1200°F and below, the Nichrome V was the stronger. Joint strengths generally fell between those of the two separate alloys. The effect of a high-temperature anneal on the strength and ductility of the joints was studied. At 1200°F and above, the brazing alloy was hot short, and joint ductility suffered correspondingly. Thermal-expansion coefficients were obtained for the brazing alloy and for two alloys of Nichrome V and the brazing alloy at temperatures up to 1800°F. The dynamic modulus of elasticity from room temperature to 1800°F was measured. No irregularities were observed in the thermal expansion or the modulus of elasticity with changes in temperature. (auth)

**6169**

Battelle Memorial Inst.

THE EFFECTS OF CHROMIUM, IRON AND NICKEL ON THE MECHANICAL PROPERTIES OF ZIRCONIUM. W. Chubb and G. T. Muehlenkamp. Aug. 11, 1954. 20p. (BMI-935)

The tensile properties, hot hardness, and impact strength of arc-melted binary alloys of iodide Zr containing up to 1 wt. % Cr, Fe, or Ni were investigated in the annealed condition. Results indicated that the alloying elements had relatively minor effect on the tensile properties of Zr at room temperature and 316°C. At room temperature either element increased the 0.2% offset yield strength of Zr from 15,000 to 25,000 psi and decreased the elongation to maximum load from 25 to 19%. Hardness data indicate that, on a wt. % basis, Cr is more effective than Fe or Ni in raising the high-temperature hardness of Zr. Chromium, Fe, and Ni reduced the impact strength of Zr. The effect of Fe was more drastic in this respect than that of Cr or Ni. (J.A.G.)

**6170**

Cornell Aeronautical Lab.

REPORT ON ITEM FOUR OF ALUMINUM WELDING ROD DEVELOPMENT FOR THE MULTI-ARC PROCESS. V. J. Pingel. May 29, 1947. 20p. Contract NOa(s)-8180. (CAL-KD-433-M-3; ATI-95951).

**6171**

Naval Engineering Experiment Station, Annapolis

TITANIUM PRODUCED BY DIRECT HOT COMPRESSION OF SPONGE METAL. W. Lee Williams. Oct. 4, 1950. 9p. (EES-4L(4)066918).

The microstructure and tensile and fatigue properties are reported for titanium metal consolidated by direct hot compression of Dupont sponge metal. The material was supplied in the "as compressed" condition. The tensile strength was low (48,000 psi), and the elongation (33%) was correspondingly high. The endurance limit was about 14,000 psi, which gave an endurance ratio of only 29%. (auth)

**6172**

Westinghouse Research Labs.

JOINING OF MOLYBDENUM. SECOND QUARTERLY REPORT. W. N. Platte and J. H. Bechtold. Mar. 16, 1953. 13p. Contract AF-18(600)-114. (GR-166; AD-11536).

**6173**

Jet Propulsion Lab., Calif. Inst. of Tech.

THE STRUCTURE OF SOME ALLOYS OF ZIRCONIUM WITH IRON, COBALT, AND CHROMIUM. PROGRESS REPORT. Charles B. Jordan and Pol Duwez. June 16, 1953. 16p. Contract DA-04-495-Ord 18. (JPL-PR-20-196; AD-23662)

The structures of  $\text{ZrFe}_2$ ,  $\text{Zr}_{0.81}\text{Fe}_{2.19}$ ,  $\text{ZrCo}_2$ , and  $\text{ZrCr}_2$  have been re-examined. The first three alloys have been found to exhibit only the  $\text{C15}(\text{MgCu}_2)$  structure;  $\text{ZrCr}_2$  has a polymorphic transition with a high-temperature phase of  $\text{C14}(\text{MgZn}_2)$  structure and a low-temperature phase of  $\text{C15}$  structure. Approximate lattice parameters are given. (auth)

**6174**

Metals Research Lab., Carnegie Inst. of Tech.

THE FREE-ENERGY CHANGE OF AUSTENITE-PEARLITE TRANSFORMATIONS. TECHNICAL REPORT FOR THE PERIOD JUNE 1, 1952-JUNE 1, 1954. William C. Hagel, Guy M. Pound, and Robert F. Mehl. June 15, 1954. 111p. Contract DA-36-061-ORD-350. (NP-5290)

A constant heat-flow calorimeter was constructed for the purpose of directly measuring the specific heat and heat of austenite-pearlite transformation in plain-carbon and alloy eutectoid steels. These data are sufficient for the determination of the free-energy change accompanying the pearlite reaction. An apparent decrease in heat of transformation with decreased pearlite spacing suggests that pearlite possesses colloidal properties. Since ferrite-cementite interfacial area can be measured with fair accuracy, relationships were established for the calculation of ferrite-cementite interfacial energy and eutectoid equilibrium temperature as a function of degree of dispersion. The resulting free-energy curves show an increase for cobalt additions and a decrease for additions of manganese and molybdenum. Diagrammatically, it appears that about 15% of the bulk free energy is retained at interfaces. (For preceding period see NP-4719.) (auth)

**6175**

Metals Research Lab., Brown Univ.

ULTRASONIC ATTENUATION IN VACUUM ANNEALED AND INTERNALLY OXIDIZED SINGLE CRYSTALS OF DILUTE COPPER ALLOYS. Chung F. Ying and Rohn Truell. July 1954. 38p. Contract DA-10-020-ORD-1512, Technical Report No. 2. (NP-5302).

Single crystals of copper alloyed with 1.00% aluminum and 0.50% aluminum, respectively, were heated at about 800°C in vacuum for over 100 hours. The attenuation of both longitudinal and transverse ultrasonic waves (10 to 75 mc/sec) in the specimens decreased from that before heating. The specimens were then heated at about 1,000°C in the presence of oxygen for over 100 hours so that they were internally oxidized extensively. The values of attenuation were higher than those after the heating in vacuum. A single crystal of copper alloyed with 0.13% beryllium was similarly heated in the presence of oxygen. The attenuation first decreased and then increased through heating. This last specimen was studied metallographically. Possible mechanisms responsi-

ble for the decrease in attenuation on annealing and for the increase on internal oxidation are discussed. Anchoring of dislocations by impurity atoms and scattering of wave energy by precipitates are probably the respective main causes. (auth)

6176

Columbia Univ., School of Mines

THE STUDY OF DIFFUSIONLESS PHASE CHANGES IN SOLID METALS AND ALLOYS. PROGRESS REPORT FOR THE PERIOD DECEMBER 1, 1953 TO FEBRUARY 28, 1954. T. A. Read, D. S. Lieberman, M. S. Wechsler, and C. W. Chen. (NYO-3965; CU-17-54-AEC-904-Met.).

Exploratory studies on the cubic to twinned tetragonal phase change in  $\text{BaTiO}_3$  have been made. This transformation is quite similar to that in  $\text{InTl}$ , and the investigation is being made to demonstrate the applicability of the recent theory of Wechsler, Lieberman, and Read to this important case. Nonequilibrium changes in Au-Cd alloys, the effect of quench on their structure, and qualitative results of changes in several physical properties are reported. (For preceding period see NYO-3964.) (auth)

6177

Sylvania Electric Products, Inc., Atomic Energy Div.

GRAIN GROWTH DURING SINTERING. H. H. Hausner. July 1, 1954. 39p. Contract AT-30-1-GEN-366. (SEP-154)

The fundamentals of grain growth in metals are described, and the equations governing recrystallization and grain growth in solid metals are discussed. Recrystallization during sintering is shown to be affected by the degree of cold work during mechanical comminution of the powder particles and during pressing the powder in the compacting die. During sintering, and sometimes also during compacting, nucleation occurs. The subsequent grain growth is, to a certain extent, hindered by the porosity of the powder compact, especially during the earlier stages of sintering. It is shown that the grain-boundary migration is not only delayed by voids but that certain grain boundaries prefer to be closely connected to the pores. The grain growth during sintering of zirconium and beryllium is discussed in detail and correlated with densification phenomena. It is finally shown that the equations for grain growth are to be modified for the grain growth during sintering of metal powders. (auth)

6178

Battelle Memorial Inst.

THE EFFECTS OF CARBON, OXYGEN, AND NITROGEN ON THE PROPERTIES OF WELDS IN TITANIUM SHEET. D. C. Martin and C. B. Voldrich. Nov. 1952. 54p. Contract AF33(038)-21385. (WADC-TR-52-294; AD-4526)

Three series of titanium alloys were melted and rolled into sheet. The first series included four titanium-carbon alloys with the carbon ranging from 0.13 to 0.74%. The second series contained three titanium-oxygen alloys with the oxygen ranging from 0.15 to 0.55%. The third series had two titanium-nitrogen alloys, one containing 0.13% nitrogen, the other, 0.24% nitrogen. A 0.50% nitrogen alloy was melted but could not be rolled into sheet. Inert-gas-shield arc welds were made in one-sixteenth and one-eighth in. sheets of each alloy. Spot-welded specimens were made with 0.032 and 0.064 in. sheets of each alloy. The physical properties of both arc welds and spot welds in each alloy were determined. The data that were obtained will be useful in establishing the allowable percentages of carbon, oxygen, and nitrogen impurities in titanium sheet. (auth)

6179

Armour Research Foundation

STUDY OF EFFECTS OF ALLOYING ELEMENTS ON THE WELDABILITY OF TITANIUM SHEET. Herbert M. Meyer and William Rostoker. May 1954. 105p. Contract AF33(616)-206. (WADC-TR-53-230)

The reactions of three basic categories of titanium alloys to heliarc welding were studied. Studies included the influence of preheat and postheat treatments on the mechanical properties of welded specimens. Mechanical properties included bend ductility, tensile strength and elongation, and hardness. Microstructures were examined extensively with a view to recording their relationships to weld behavior. A large number of alloys proved extremely brittle in the as-welded state. In almost every case, a large measure of ductility could be restored by postheat treatment. Preheat treatment did not generally improve the ductility of the as-welded state. No single postheat treatment procedure was found applicable to all alloys. A number of commercial alloys were examined. In RC-130A alloy brittle welds could be rendered ductile by postheat treatment. (auth)

6180

New York Univ. Coll. of Engineering

MECHANISM OF MARTENSITIC TRANSFORMATION OF TITANIUM ALLOYS. FINAL REPORT. Y. C. Liu. June 1, 1954. 37p. Contract DA-30-069-ORD-823. (WAL-401/88-34).

The orientation relationship between the  $\beta$  matrix and martensite of  $\{334\}_\beta$  habit was determined for binary Ti alloys with Cr, Fe, Mn, and Mo. Two orientation relationships between the matrix and martensite of  $\{344\}_\beta$  habit were suggested. The suggested relationships did not vary with the alloying element. From the microstructure study of the exposed martensite platelets, a general mechanism of the martensite transformation was presented. (For preceding report in series see WAL-401/88-28.) (J.S.R.)

6181

Connecticut Univ.

GRAIN GROWTH AND RECRYSTALLIZATION IN TITANIUM AND ITS ALLOYS. PART I. EXCESSIVE GRAIN COARSENING. PART 2. GRAIN GROWTH AND RECRYSTALLIZATION STUDIES. FINAL TECHNICAL REPORT. Edward L. Bartholomew, Jr. June 10, 1954. 73p. Contract DA-19-059-ORD-493. (WAL-401/131-13).

The influence of temperature, time, amount of cold deformation, and prior to deformation grain size on grain size of cold-worked and annealed titanium (RC-55) and three alloys, Ti-100A, Ti-150A, and RC-130A, is reported. Results of isothermal annealing microstructural studies to determine the kinetics of recrystallization and mechanisms of grain growth in cold-rolled and annealed titanium (RC-55) are also reported. (auth)

6182

New York Univ. Coll. of Engineering

BETA PLASTICITY IN TITANIUM-BASE ALLOYS. INTERIM TECHNICAL REPORT NO. 3. P. Albert and R. Sheeran. Apr. 27, 1954. 23p. Contract DA-30-069-ORD-869. (WAL-401/147-19).

In order to determine the modes of deformation in  $\beta$  titanium alloys, wire textures were obtained with single-phase  $\beta$  (stable),  $\alpha$  + stable  $\beta$ , metastable  $\beta$ ,  $\alpha$  + metastable  $\beta$ , or  $\alpha$  +  $\alpha$  structures. The single-phase  $\beta$  texture was found to be a simple  $\langle 110 \rangle$  texture, and the textures of the  $\alpha$  + stable  $\beta$

alloys was a superimposition of the  $\langle 110 \rangle \beta$  and the  $\langle 1010 \rangle \alpha$  textures. All the other structures showed only the  $\alpha \langle 1010 \rangle$  texture after deformation. (For preceding period see WAL-401/147-18.) (J.A.G.)

### 5183

Rensselaer Polytechnic Inst.

A STUDY OF TRANSFORMATION CHARACTERISTICS OF WELD METALS AND BASE METALS. INTERIM TECHNICAL REPORT. Ernest F. Nippes and Edward C. Nelson. Jan. 25, 1953. 91p. Contract DA30-115-ORD-250. (WAL-642/156-14; AD-12974)

An understanding of the metallurgical phenomena which occur in the heat-affected zone of a weld requires a knowledge of the continuous cooling transformation characteristics of steels which were heated to various temperatures in the austenitic phase region at heating rates comparable to those encountered in a weld. A high-speed dilatometer can be used to produce this kind of information, and techniques were developed to protect dilatometer specimens from decarburization at extremely high temperatures. The continuous cooling transformation characteristics of Carnegie armor plate were investigated for a number of maximum temperatures. Photomicrographs illustrate the effect of maximum temperature on the transformation structures. The transformation behavior of the steel is presented in transformation isotherm diagrams which permit the calculation of the metallurgical structure for any cooling rate and maximum temperature. (auth)

### 5104

ON A NEW EFFECT IN THE ELECTROLYTIC TRANSFER IN SOLID ALLOYS. W. Seith and H. Wever. Translated from *Z. Elektrochem.* 57, 891-900(1953). 18p. (AERE-Trans-11/3/5/434)

Investigations of electrolytic transport in the region of the  $\beta$  Hume-Rothery phase in  $\text{Cu}_3\text{Al}$  led to the conclusion that the mobilities of ions types during transport in metallic systems are practically independent of one another and that a binary system is characterized by two transport numbers, a common one which describes the common transport of both components to an electrode and a relative one which determines the transport of the one component relative to the other. Studies which led to this conclusion are reported in detail. (C.H.)

### 6185

THERMAL CONDUCTIVITY OF METALS AND ALLOYS AT LOW TEMPERATURES. A REVIEW OF THE LITERATURE. Robert L. Powell and William A. Blanpied. *Natl. Bur. Standards (U. S.) Circ.* 556, Sept. 1, 1954. 68p.

An extensive compilation is given of the measured values of thermal conductivity for metals and alloys from room temperature down to approximately 0°K. The more extensive and important data are plotted in 48 graphs. The tables and graphs for the metallic elements and alloys are essentially complete for literature reference from 1900 to early 1954. For comparison, several graphs and tables are given for some representative dielectrics. (198 references.) (auth)

### 6186

CORRELATION OF POLARIZED LIGHT PHENOMENA WITH THE ORIENTATION OF SOME METAL CRYSTALS. C. J. Newton and H. C. Vacher (National Bureau of Standards, Washington D. C.). *J. Research Natl. Bur. Standards* 53, 1-12(1954) July.

A photometric study was made of the reflection of plane polarized light normally incident in a metallographic micro-

scope upon specimens of tin, aluminum, and monel, with various surface treatments. A high degree of correlation was found in most cases between the extinction position and the projection of the optic axis or of the cubic axis making the greatest angle with the surface normal. Moreover, a fourth power sine relationship was observed between the change of intensity and the angle between the surface normal and the optic axis in tin. The intensity correlation in the case of the cubic metals was not so clear, but a slight indication of position dependence was observed for aluminum. The results indicate that the optically anisotropic effects observed with cubic metals can be caused both by anisotropic films and by oriented surface contours, but that the latter is the source of those effects that are correlated with the crystallographic orientation of the grain. (auth)

### 6187

CRYSTAL STRUCTURE AND THERMODYNAMIC STUDIES ON THE ZIRCONIUM-HYDROGEN ALLOYS. Earl A. Gulbransen and Kenneth F. Andrew (Westinghouse Research Labs., East Pittsburgh, Penna.). *J. Electrochem. Soc.* 101, 474-80(1954) Sept.

The phase diagram of zirconium-hydrogen alloys was studied on alloys prepared at low temperature and for alloys in the composition range of  $\text{ZrH}_{0.625}$  to  $\text{ZrH}_{1.865}$ . Decomposition pressure studies were made over the composition range and for a series of temperatures. Results of these measurements were in complete agreement with crystal structure studies on the major phases. Results show presence of two major hydride phases, namely, the  $\delta$  and  $\epsilon$  phases as described by Hägg. No evidence was found for either the  $\gamma$  or  $\beta$  phases of Hägg, although the latter phase was found only at high temperature by Hägg. The  $\epsilon$  phase was found to have a wide range of homogeneity from  $\text{ZrH}_{1.865}$  to about  $\text{ZrH}_{1.65}$ . The  $\delta$  phase was found to have a composition near  $\text{ZrH}_{1.50}$  and a range of homogeneity from  $\text{ZrH}_{1.4}$  to  $\text{ZrH}_{1.55}$ . A new minor transitional phase was found having the face-centered tetragonal structure and existing only in the presence of  $\alpha$  Zr and  $\delta$  phases. It has been designated as the  $\gamma'$  phase since its composition is probably near that of Hägg's  $\gamma$  phase. The free energy of formation of the  $\delta$  phase in contact with  $\alpha$  Zr containing hydrogen was determined from decomposition pressure data. (auth)

### 6188

DETERMINATION OF BARRIER LAYER THICKNESS OF ANODIC OXIDE COATINGS. M. S. Hunter and P. Fowle (Aluminum Company of America, New Kensington, Penna.). *J. Electrochem. Soc.* 101, 491-5(1954) Sept.

A novel method is described for measuring the thickness of a barrier-type anodic oxide coating or the barrier layer portion of a porous type anodic oxide coating. This method is used to follow the evolution of the barrier layer during the early stages of the formation of a porous type coating on aluminum and to establish certain dimensions of the fundamental oxide cells which comprise this type of coating. (auth)

### 6189

A SIMPLE ANODISING PROCESS FOR REVEALING THE GRAIN STRUCTURE OF ALUMINIUM ALLOYS. H. G. Cole and W. J. D. Brooks. *Metallurgia* 50, 97-100(1954) Aug.

The grain structure of a wide range of aluminium-base materials in rolled, extruded, and cast form can be observed under polarized light after the metal surface has been anodized at 2.5 amp/dm<sup>2</sup> in a 50% aqueous solution of phosphoric acid. Best results are obtained if the process is carried out in the region of 0°C. (auth)

## 6190

X-RAY MEASUREMENT OF ORDER IN CuAu. B. W. Roberts (General Electric Research Lab., Schenectady, N. Y.). *Acta Met.* 2, 597-603 (1954) July.

The long-range order in CuAu has been measured with a Gelfer counter spectrometer using filings quenched from various annealing temperatures. The long-range order is essentially perfect at low temperature and decreases to about 0.97 at 380°C, where the material changes to CuAuII. Short-range order coefficients were determined from measurements of the diffuse intensity from a single crystal of CuAu. The coefficients indicate a preference for unlike nearest neighbors, and they are qualitatively similar to those for Cu<sub>3</sub>Au. An outward shift of the 100 and 300 diffuse peaks suggests but does not prove the existence of a microlayering, similar to CuAuI, even above the critical temperature. (auth)

## 6191

EFFECT OF ORIENTATION DIFFERENCE ON THE PLASTIC DEFORMATION OF ALUMINUM BICRYSTALS. K. T. Aust and N. K. Chen (Johns Hopkins Univ., Baltimore, Md.). *Acta Met.* 2, 632-8 (1954) July.

Single crystal and bicrystal specimens of high-purity aluminum having controlled orientations were grown from the melt using "seeding" techniques. The crystals were similarly oriented with respect to the specimen axis which was located near (110) in the stereographic projection. The effect of varying the orientation difference, by rotations about the specimen axis, on the tensile stress-strain curves and slip characteristics was studied up to 2 per cent deformation. An increase in orientation difference was found to have a marked effect on inhibiting the initial plastic deformation and on modifying the subsequent stages of deformation. The yield stress and the rate of strain hardening increased, and the "easy" glide region was shortened, as the orientation difference between neighboring crystals increased. The shortening of the "easy" glide region was related to the increased amount of double glide observed in the vicinity of the grain boundary. The operative slip planes in the bicrystal specimens were determined to be the same as those which occur for a single crystal stressed in a similar manner. The results were discussed in terms of a slip activation process and the obstruction of dislocations at the grain boundary. (auth)

## 6192

THE ORDER-DISORDER TRANSFORMATION IN Cu-Au ALLOYS NEAR THE COMPOSITION Cu<sub>3</sub>Au. J. B. Newkirk (General Electric Research Lab., Schenectady, N. Y.). *Acta Met.* 2, 644-5 (1954) July.

The x-ray diffraction data of Jaumot and Sutcliffe (*Acta Met.* 2, 63-74 (1954) Jan.) on Au-Cu alloys is interpreted to give a diagram of normal construction in the Cu<sub>3</sub>Au region instead of the unusual construction originally proposed. The present diagram permits a reasonable quantitative estimate of the 2-phase (order + disorder) regions on each side of Cu<sub>3</sub>Au. (J.S.R.)

## 6193

CREEP-RUPTURE CHARACTERISTICS OF Al-Mg SOLID-SOLUTION ALLOYS. Arthur W. Mullendore and Nicholas J. Grant (Massachusetts Inst. of Tech., Cambridge). *J. Metals* 6, Sect. 1, 973-9 (1954) Sept.

Three aluminum alloys of 0.94, 1.92, and 5.10% Mg, prepared from very high purity metals, were tested at 500, 700, and 900°F in creep rupture. The degree of strengthening

through solid-solution alloying and the effects on the deformation characteristics and fracture were examined. The ductility of the alloys as a function of stress and temperature was closely followed. (auth)

## 6194

INFLUENCE OF OXYGEN AND NITROGEN IN SOLUTION IN ALPHA TITANIUM ON THE FRICTION COEFFICIENT OF COPPER ON TITANIUM. W. R. Yankee and E. S. Machlin (Columbia Univ., New York). *J. Metals* 6, Sect. 1, 989-90 (1954) Sept.

A correlation between friction data and mechanical properties of Cu on Ti is demonstrated. It is shown that the friction coefficient of oxidized or nitrided surfaces of Ti will be low with the solute in solution and the oxides or nitrides absent. The optimum cutting conditions vary with the interstitial content of Ti, in view of the probability that the friction coefficient between work and tool would vary likewise. It was observed that the lower the O or N content, the better will be the solid-phase weldability. With respect to ductility of Ti containing O or N a marked loss of ductility is found to occur above 0.3% O and 0.1% N. (J.E.D.)

## 6195

RATE OF SELF-DIFFUSION IN POLYCRYSTALLINE MAGNESIUM. P. G. Shewmon and F. N. Rhines (Carnegie Inst. of Tech., Pittsburgh, Penna.). *J. Metals* 6, Sect. 2, 1021-5 (1954) Sept.

The determination of the self-diffusion coefficient of Mg was made possible by discovery of Mg<sup>28</sup>, with a half life of 21.3 hr. This material was condensed from the vapor phase upon a surface of high purity of Mg. The progress of diffusion of the tracer atoms into polycrystalline Mg was followed by machining layers and measuring the change in the intensity of radiation as a function of the distance of each layer from the surface. The self-diffusion coefficient was found to be  $2.1 \times 10^{-8}$  cm<sup>2</sup>/sec at 627°C,  $3.6 \times 10^{-9}$  cm<sup>2</sup>/sec at 551°C, and  $4.4 \times 10^{-10}$  cm<sup>2</sup>/sec at 468°C; the activation energy found to be about 32,000 cal/mole. (J.E.D.)

## 6196

COEFFICIENTS OF THERMAL EXPANSION FOR ZIRCONIUM. R. B. Russell (Massachusetts Inst. of Tech., Cambridge). *J. Metals* 6, Sect. 2, 1045-52 (1954) Sept. (cf. NSA 5-7099).

The expansion coefficients of hexagonal ( $\alpha$ ) zirconium have been calculated from the lattice parameters of both low and high hafnium alloys in the range 0 to 600°C. It is found that the coefficients are straight-line functions of the temperature and the effect of hafnium is to depress the mean coefficients by about 1% at room temperature and 9% at 600°C. The cubic ( $\beta$ ) form was stabilized so that its coefficient could be determined from 400 to 900°C. (auth)

## 6197

CORRELATION BETWEEN MICROSTRUCTURE AND RESISTIVITY OF TRANSFORMING Ti-Mn ALLOYS. D. J. DeLazaro and D. W. Levinson (Armour Research Foundation, Chicago). *J. Metals* 6, Sect. 2, 1089-93 (1954) Sept.

Observations were made of the isothermal transformation and quench and reheat transformation characteristics of binary titanium alloys containing nominally 6 wt.% and 10 wt.% Mn at temperatures of 700, 600, 500, and 400°C. A large change in electrical resistivity attends the beta to alpha transformation in these alloys. The correlation between the resistivity and microstructure provides a very sensitive means of following the transformation. (auth)

## 6198

SIGMA PHASE—A REVIEW. Adolph J. Lena (Allegheny Ludlum Steel Corp., Brackenridge, Penna.). *Metal Progr.* 66, No. 3, 122-8(1954) Sept.

Significant investigations made of the formation of sigma phase and its effect on the properties of alloys are reviewed. The sigma is identified by microscopic methods and by x-ray analysis of the bulk material or the concentrated phase. Sigma occurs in many binary and ternary systems, some of which compose the high-temperature alloys. (J.E.D.)

## PHYSICS

## 6199

Tracerlab, Inc.

INVESTIGATIONS ON UTILIZATION OF RADIOACTIVE ENERGY AS A SOURCE OF BATTERY POWER. SECOND QUARTERLY PROGRESS REPORT [FOR] NOVEMBER 1, 1952 TO JANUARY 31, 1953. 49p. Contract DA-36-039-SC-42549. (AD-5048)

Ion chamber collection theory is evolved, and relations are derived which predict the current-voltage characteristics for a nuclear battery consisting of a stack of parallel plates of dissimilar metals between which a gas is uniformly volume ionized by the radiation. Using simplifying assumptions involving the ionic mobilities and recombination coefficients, the theory is applied to two actual models being constructed, and a graph of the expected characteristics is given and discussed. Based on quantum statistical methods of solid-state theory, the factors influencing contact potential difference are presented, and their practical implications are discussed. Experimental work on monomolecular layers of calcium stearate for depressing or elevating the work function and the difficulties in experimental techniques that were encountered in this work are described. The experimental work leading to the selection of sputtered platinum on aluminum as the best immediately practical electrodes is also presented. Considerations that went into the detailed design of the 60-volt battery model are given, and an assembly drawing is included. The problems of filling the batteries with radioactive gas are presented. One method is illustrated, and its limitations are discussed. (auth)

## 6200

Georgia Inst. of Tech. Engineering Experiment Station STANDARDIZATION OF SURFACE PROPERTIES OF FINE PARTICLES. QUARTERLY REPORT NO. 1. J. M. Dallavalle, Clyde Orr, Jr., and H. G. Blocker. July 30, 1953. 14p. Contract DA-36-039-SC-42588. (AD-16835)

An evaluation of the surface properties of finely divided solids such that the standardization of these properties may eventually be attained and the heat released upon the adsorption of a gas by powders are reported. A suitable instrument was devised for making these heat of adsorption measurements, and a number of measurements were made. All indicated that the heat liberated upon the adsorption of a unit quantity of gas varies as the surface of the solid adsorbent is covered. The first small increment of gas adsorbed by coconut charcoal gives up a quantity of heat that seems to be approximately equal to the heat of liquefaction of the gas at that temperature, while later increments of adsorbing gas give up considerably greater increments of heat until the surface is covered with a

monomolecular layer at which conditions only heat equivalent to liquefaction is released. (auth)

## 6201

Tracerlab, Inc.

INVESTIGATIONS ON UTILIZATION OF RADIOACTIVE ENERGY AS A SOURCE OF BATTERY POWER. FOURTH QUARTERLY PROGRESS REPORT [FOR] MAY 1, 1953 TO JULY 31, 1953. Alexander Thomas. 50p. Contract DA-36-039-SC-42549. (AD-19099)

Aluminum and aluminum alloys as the low work function electrode lose their initial high CPD with respect to platinum to below one volt on exposure to air. Magnesium becomes relatively stable at 1.2 to 1.3 volts after half an hour in air. Evaporated arsenic is proposed as a substitute for sputtered platinum. Experiments with hydrogen glow discharge to decrease the terminal leakage and to increase the voltage are described. The increase in voltage from this treatment when the low work function electrode is oxidized aluminum is only temporary. Equivalent electrical network analysis applied to current-voltage data taken repeatedly over a period of time showed that the terminal leakage was negligible and that the slope of the current-voltage characteristics at voltages sufficient to collect all of the gaseous ionization was due to radiation-induced conductivity of the insulator. This insulator conductivity increased slightly at first then decreased by a factor of about 3 after 30 days. Theoretical relations giving wall absorption of primary particles are applied to the experimentally determined gaseous saturation currents at highest argon pressure and compared with observed saturation currents at lower partial pressures of argon. (For preceding report see AD-14239.) (auth)

## 6202

Georgia Inst. of Tech. Engineering Experiment Station STANDARDIZATION OF SURFACE PROPERTIES OF FINE PARTICLES. QUARTERLY REPORT NO. 3. Clyde Orr, Jr., H. G. Blocker, and D. Jane Barrett. Jan. 30, 1954. 25p. Contract DA-36-039-sc-42588. (AD-26832)

Preliminary work is reported from studies of the heats of absorption when a gas comes into contact with a solid. Refinements in apparatus and techniques are described for purification of  $N_2$  and He gases, pressure measurement, and sample preparation. Preliminary data are included on the adsorption of  $N_2$  gas on charcoal. (For preceding period see AD-21860.) (C.H.)

## 6203

Cryogenic Lab., Ohio State Univ.

[LIQUID HYDROGEN AS AN AIRCRAFT FUEL]. TECHNICAL REPORT NO. 27. COEFFICIENT OF THERMAL EXPANSION OF SOLIDS AT LOW TEMPERATURE. 3. THE THERMAL EXPANSION OF PURE METALS, WITH THE DATA FOR ALUMINUM, NICKEL, TITANIUM, AND ZIRCONIUM. H. W. Altman, T. Rubin, and H. L. Johnson —[Marjorie Lassette, ed.]. Feb. 10, 1954. 14p. Contract W-33-038 ac 14794 (16243). (AD-26970; TR 264-27)

Thermal expansion coefficients were determined in the temperature range from 20 to 300°K for Al, Ni, Ti, and Zr. (J.S.R.)

## 6204

Ames Lab.

MECHANISM OF HINDERED SETTLING AND FLUIDIZATION. Albert L. Loeffler, Jr. and B. F. Ruth. Dec. 1953. 64p. Contract W-7405-eng-82. (ISC-468)

This study was undertaken with the ultimate object of

verifying the theory for describing the operation of a spray-type liquid-liquid extraction column. Due to the inherent difficulty in maintaining proper control of variables in liquid-liquid systems the experimental work was done with liquid-solid systems. Closely sized glass spheres were fluidized in glass tubes with various liquids, observing the equilibrium heights to which beds of spheres ranging in size from 0.0035 to 0.20 in. in diameter expanded at various fluid velocities. (auth)

**5205**

Research Lab. of Electronics, Mass. Inst. of Tech. QUARTERLY PROGRESS REPORT [NO. 34 FOR THE PERIOD ENDING MAY 31, 1954]. J. B. Wiesner, G. G. Harvey, and H. J. Zimmermann. July 15, 1954. 123p. Contract DA-36-039-sc-100. (NP-5287)

An exact solution has been obtained for the diffusion equation which describes the electron energy distribution in discharges near a plasma resonance at low pressures. Further studies on the hyperfine structure of positronium are reported. A microwave bridge has been designed for measuring the dielectric coefficient of semiconductors. Measurements have been made of the velocity and absorption of first sound in liquid He at temperatures between 0.1 and 1.1°K, using a pulsed ultrasonic technique. The demagnetization cryostat is described. Several noise curves have been obtained for a low-noise, three-region electron gun. Transistor circuits for a voltage-regulated power supply and a time modulator have been developed. An analyzer circuit for investigating noise in semiconductors was designed. Further data on the electrical characteristics of T-ridge waveguides are presented. Topics on speech analysis and communications biophysics are given, together with theoretical studies connected with analog computer research and network analysis. (For preceding period see NP-5181.) (K.S.)

**5206**

Columbia Radiation Lab., Columbia Univ. QUARTERLY [PROGRESS] REPORT. July 30, 1954. 32p. Contract DA-36-039-SC-42519, Report No. 7. (NP-5301; CU-7-54-SC-42519-Phys.)

Considerable success has been achieved in the design of a tunable magnetron at the 1-cm range. A tuning range of 0.15 cm at a mean wave length of about 1.25 cm has been achieved. The tube operates over the whole region and no discontinuities in operation are observed. Pseudo-cw tubes to operate at low magnetic field and a wave length of about 1.3 cm have been constructed. Hyperfine structure of the  $\text{NH}_3$  spectrum was measured in some detail with apparatus for the molecular beam oscillator and to an accuracy of about 1 kc/sec. The structure is explained theoretically except for minor discrepancies. The spectrum of tritium iodide was obtained near 2.4 mm wavelength, and the mass of tritium thereby measured. (auth)

**5207**

Applied Science Research Lab., Univ. of Cincinnati A STUDY OF POROUS MEDIA BY MEANS OF FLOW METHODS. THE SURFACE AREA OF CARBON BLACKS. Gerard Kraus and John W. Ross. July 30, 1954. 35p. Contract DA-33-008-ord-123, Technical Report No. 3. (NP-5303)

A study of the dependency of the apparent Knudsen-flow surface area on the porosity of packing of acetylene carbon black and Gastex carbon black is reported. Surface-diffusion measurements at 0 and 37.15° were made with n-

butane on a sample of Graphon carbon black. A plot of the surface-diffusion coefficient against the fraction of monolayer coverage shows a maximum just beyond the B. E. T. monolayer coverage. Isoteric heats of adsorption calculated from isotherms at the two temperatures show a maximum just below the B. E. T. monolayer value. (J.E.D.)

**5208**

Bureau of Aeronautics, Dept. of the Navy PROCEEDINGS [OF] PROJECT TYPHOON SYMPOSIUM III ON SIMULATION AND COMPUTING TECHNIQUES [HELD AT THE] UNIVERSITY OF PENNSYLVANIA MUSEUM AUDITORIUM [ON] OCTOBER 12, 13, AND 14, 1953. PART 1. Bureau of Aeronautics, Dept. of the Navy and Naval Air Development Center, Johnsville, Penna. 432p. (NP-5315(pt.1))

**5209**

VARIOUS METHODS FOR THE EXPERIMENTAL DETERMINATION OF THE SIZE OF MINUTE PARTICLES BY MEANS OF X-RAYS. G. Wiedmann and G. Freyer. Translated from *Fortschr. Gebiete Röntgenstrahlen* 61, 119-27 (1940). 9p. (AERE-Trans-11/3/5/423)

X-ray methods for the determination of the size of minute particles were tested by photographs of specimens of Au, Ag, and MgO. It is confirmed that the formula of Scherrer is applicable only to strongly absorbent preparations and gives very inaccurate results. It is also established that the method devised by Brill, which is based on the use of a lead-glass nucleus, gives accurate results in all cases and is the most accurate method yet known. Brill's approximate equation is also fairly accurate. Brill's method with hollow tubes is tested and found imperfect. The reason for this lies in the curve given by Brill. A new formula is empirically discovered and experimentally confirmed. To overcome variations in absorption in the preparation, a method is developed in which the substance to be investigated is irradiated in foil form. Both cylindrical and flat film are used. In the evaluation of these photographs, which is carried out with Scherrer's equation, it is necessary to modify the equation. (auth)

**5210**

ON THE SCHRÖDINGER EQUATIONS FOR ATOMIC HELIUM. V. A. Fok. *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* 18, 161-72 (1954) Mar.-Apr. (In Russian).

The Schroedinger equation for atomic He is analyzed, and a method for the successive derivation of its terms is given. (J.S.R.)

**5211**

ENERGY THRESHOLDS FOR THE DECOMPOSITION OF HEAVY NEGATIVE IONS IN COLLISIONS WITH HELIUM ATOMS. V. M. Dukel'skii and E. Ya. Zandberg. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 339-41 (1953) Mar. (In Russian).

Results are graphed and tabulated of experiments on collisions of He with ions  $\text{Te}^-$ ,  $\text{Te}_2^-$ ,  $\text{Bi}^-$ , and  $\text{Sb}_2^-$ . The following energy threshold values (in He gas at a pressure of  $10^{-3}$  mm Hg) have been determined:  $\text{Te}^-$ , 180 ev;  $\text{Te}_2^-$ , 340 ev; and  $\text{Sb}_2^-$ , 200 ev; the value obtained for  $\text{Bi}^-$  is uncertain. It is suggested that the threshold for the decomposition is determined by the energy  $W_0$  required to bring the ion, in the case of central collision, to the critical distance  $r_0$  from the atom;  $W_0$  should be greater than  $S$  (the bonding energy of the excess electron). (Science Abstracts)

**6212**

MULTIPLIER FOR ANALOG COMPUTERS. C. J. Savant,

Jr. (Univ. of Southern California, Los Angeles) and R. C. Howard (Bell Telephone Labs., New York). *Electronics* **27**, No. 9, 144-7 (1954) Sept.

## 6213

MEMORANDUM ON GAMMA-RAY SOURCES FOR RADIOGRAPHY. SECOND EDITION. London, England, The Institute of Physics, 1954, 28p. \$0.90.

Data on  $\gamma$ -ray sources available for industrial radiography are summarized. General problems, radiography techniques, protection of personnel, and costs involved are discussed. An appendix summarizes data on Ra, Rn, and isotopes of Co, Ta, Cs, Ir, and Tm. (C.F.)

## 6214

GASEOUS REACTIONS INVOLVING POSITRONIUM. H. S. W. Massey and C. B. O. Mohr (Univ. Coll., London, England). *Proc. Phys. Soc. (London)* **A67**, 695-704 (1954) Aug.

The problems involved in providing a detailed interpretation of the processes involved in the ultimate fate of positrons slowed down in a gas are examined by considering the idealized case of a gas of atomic hydrogen. The processes leading to the formation and dissociation of positronium are considered as well as those which lead to the slowing down of a positronium pair in a gas and to the conversion of ortho- into para-positronium. It is shown that the rate of the latter process probably depends strongly on the kinetic energy of the pair. Elastic collisions of a pair, in its ground state, with gas atoms are determined almost completely by electron exchange interaction, but this is so strong that it cannot be taken account of in a weak coupling treatment. (auth)

## 6215

FURTHER CONSIDERATIONS REGARDING LIQUID HELIUM II AT HIGH PRESSURES. Ziro Mikura (Tohoku Univ., Japan). *Progr. Theoret. Phys. (Japan)* **11**, 503-4 (1954) Apr.-May.

The calculation of specific heats and thermal Rayleigh disk torques of  $\text{He}^3$ - $\text{He}^4$  mixtures and pure  $\text{He}^4$  at high pressures, from theory previously developed, yields values in good agreement with experiment. (K.S.)

## 6216

ON THE THERMAL RAYLEIGH DISK IN LIQUID HELIUM CONTAINING  $\text{He}^3$ . Ziro Mikura (Tohoku Univ., Japan). *Progr. Theoret. Phys. (Japan)* **11**, 504-5 (1954) Apr.-May.

The effect of  $\text{He}^3$  dilution of  $\text{He}^3$ - $\text{He}^4$  mixtures on the decrease of thermal Rayleigh disk torque is theoretically explained by the assumption that  $\text{He}^3$  moves with the same velocity as the normal fluid. (K.S.)

## AEROSOLS

### 6217

AUTORADIOGRAPHY OF ATMOSPHERIC AEROSOLS. G. Aliverti, and A. De Maio (Istituto Superiore Navale, Naples, Italy) and G. Lovera and R. Perilli-Fedeli (Univ. of Modena, Italy). *Nuovo cimento* (9) **12**, 270-8 (1954) Aug. (In Italian).

By the technique of nuclear emulsions, the collection, through the electrical effluvia, is investigated of the short-lived radioactive atoms, following the parent Rn in the disintegration series, which are present in the atmospheric air and particularly of  $\text{Po}^{218}$  on the basis of observations of two-branched events formed by tracks of  $\text{Po}^{218}$  and  $\text{Po}^{214}$   $\alpha$  particles coming from subsequent decays of a radioactive atom. Some critical considerations are discussed, about the frequencies that may be foreseen of the two-branched

events with respect to the single tracks and about the defects and causes of errors of the collecting and observing methods. The results of a set of measurements are reported, from which it follows that the  $\text{Po}^{218}$  atoms also are deposited by the effluvia, in confirmation of what had already been ascertained in the past by means of ionization chamber measurements. (auth)

## COSMIC RADIATION

### 6218

CONCERNING THE ORIGIN OF HEAVY FRAGMENTS OF HIGH ENERGY UPON THE DISINTEGRATION OF NUCLEI BY COSMIC RAYS. V. I. Veksler. Translated by Bonnie C. Hubbard from *Doklady Akad. Nauk S.S.S.R.* **82**, 865 (1952). 2p. (UCRL-Trans-179)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 6-3596.

### 6219

POSSIBLE EXAMPLE OF THE ANNIHILATION OF A HEAVY PARTICLE. H. S. Bridge, H. Courant, H. De-Staebler, Jr., and B. Rossi (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **95**, 1101-3 (1954) Aug. 15.

An unusual cloud chamber photograph was obtained in a chamber containing 11 brass plates, each 0.50-in. thick. Three electron showers are associated with the stopping of a charged particle in one of the plates. The event is difficult to interpret on the basis of spontaneous decay or nuclear absorption, and it suggested that the incident particle might be an antiproton undergoing annihilation with an ordinary proton. (K.S.)

### 6220

ANOMALOUS EVENT OBSERVED IN PHOTOGRAPHIC EMULSION. J. H. Noon, M. F. Kaplan, and J. Crussard (Univ. of Rochester, N. Y.). *Phys. Rev.* **95**, 1103-4 (1954) Aug. 15.

A fast Be nucleus was found which interacted in a 400  $\mu$  G-5 stripped emulsion to produce a  $6 + 1_{Be}$  star. Two of the prongs are relativistic particles of charge 3 and 2, each making an angle of less than  $2 \times 10^{-3}$  radian with the primary. The triply charged particle produces a  $0 + 6_{Li}$  star after 5.09 cm. The doubly charged particle travels for 1.37 cm, thence splitting into two fast singly-charged particles. The latter event shows no evidence of nuclear interaction and is coplanar. Several possible explanations of the event are discussed. (K.S.)

### 6221

ON THE PRODUCTION OF CHARGED MESON PAIRS BY NEUTRAL PARTICLES IN COSMIC RAYS. S. B. Roy and R. Chakravarti (Indian Association for the Cultivation of Science, Calcutta). *Indian J. Phys.* **28**, 167-76 (1954) Apr.

The investigation reported by Janossy and Rochester (*Nature* **148**, 531 (1941)) has been repeated using a modified arrangement so that instead of shielding the whole threefold coincidence counter telescope with anticounters, only the topmost coincidence counter has been shielded almost completely with anticounters. It has been observed that the number of anticoincidences increases slightly even when a lead absorber placed between the two upper coincidence counters is moved from its position just above the lower counter to one just below the upper counter, but the number increases further when the absorber is shifted from the latter position to one just above the topmost coincidence counter. This increase is again found to be the same as that

observed with the diminution of the thickness of a lead absorber placed above the anticounters from 21 to 2.5 cm. This increase is found to be statistically significant and about 0.4% of the total number of the total number of charged mesons recorded with the same arrangement. It is pointed out that the low value, 0.035%, reported by Janossy and Rochester, is due to the failure of the arrangement to record events in which the neutral particles produced at least two charged mesons moving in widely different directions. (auth)

6222

ANGULAR DISTRIBUTIONS IN COSMIC RAY STARS AT 3500 METERS. M. Conversi and P. Rothwell. (Univ. of Pisa, Italy) *Nuovo cimento* (9) 12, 190-210(1954) Aug. (In English)

Cosmic-ray stars have been investigated at 3,500 m using an ion chamber surrounded by G-M counters connected to a 22-channel hodoscope. The events were recorded by a teletypewriter triggered by the hodoscope, so that a reconstruction of the mutual positions of the stars prongs could be obtained for each event. The analysis reported here refers to about 13,000 stars having either at least one secondary branch able to cross 1.2 g/cm<sup>2</sup> of brass or no such branch. These detectable prongs were protons of energy greater than 25 Mev or mesons of energy greater than 10 Mev. Using photographic emulsion results it is shown that the average energy,  $\bar{W}$ , of the nucleons producing the interactions is about 60 Mev for the stars without detectable prongs and in the neighborhood of 750 Mev for the stars having at least one prong. The zenith angle distribution of these nucleons is well represented by  $\cos^m \alpha$ , and  $m$  varies from  $2.1 \pm 0.3$  to  $2.6 \pm 0.3$  between  $\bar{W} = 60$  Mev and  $\bar{W} = 750$  Mev. It is found, furthermore, that roughly the same distribution holds for both proton and neutron forming stars. The angular distributions of the secondary prongs have been deduced with respect to the vertical and to the direction of the primary. Analytical expressions in terms of power of the cosine of the angle are obtained for the experimental distributions referring to the projections of the tracks on a plane. The distributions in space are derived from these plane distributions through the solution of an integral equation, and they are polynomials of the same type. Comparison of the distributions with those obtained from analysis of stars produced by 300 to 400 Mev nucleons suggests that: (a) the cross section for meson production is still very small at energies of 700 to 800 Mev; (b) the cross section for elastic scattering in nucleon-nucleon interactions remains probably almost constant between 300 and 750 Mev. (auth)

6223

THE MULTIPLE CORE STRUCTURE OF AIR SHOWERS. W. P. Davis, W. E. Hazen, and R. E. Heineman (Univ. of Michigan, Ann Arbor). *Nuovo cimento* (9) 12, 233-42(1954) Aug. (In English)

The lateral density distribution of electrons in air showers has been observed at 3,260 m altitude with an assembly of ionization chambers. The resolution was about 20 cm for 1/r peaks within the main array of 18 chambers. The absolute intensity of showers of size  $10^5 < N < 10^6$  agrees with previous observations. Multiple peaks were observed, and their spatial distribution indicates a mean separation of about 50 cm. The problem of a model for the production of the multiple-cored showers that is consistent with the observations is described. (auth)

6224

ANALYSIS OF TWO K EVENTS. D. Hirschberg and L.

Hirschberg (Université Libre de Brussels, Belgium). *Nuovo cimento* (9) 12, 296-9(1954) Aug. (In French).

Two K events were observed in nuclear emulsions exposed at high altitudes. The first ( $K_1$ ) was conventional K meson. It disintegrated, emitting a rapid secondary. The mass was calculated as  $M_{-85}^{+105} m_e$ . The second K meson ( $K_2$ ) could be considered as a negative K since the secondary, a light meson of low energy, stopped in the emulsion without giving any visible secondary tracks. The end of the meson was in a very favorable region for observation and the vicinity was scanned with the greatest care without finding any disintegration electron. The mass of  $K_2$  was calculated as  $M_{-250}^{+400} m_e$ . Possible interpretations of the absence of a trace of disintegration of the secondary meson are discussed. (J.S.R.)

6225

PRIMARY COMPONENTS OF COSMIC RADIATION. M. I. Fradkin. *Uspekhi Fiz. Nauk* 53, 305-80(1954) July. (In Russian).

The present article contains a review of the contemporary experimental data on the primary components of cosmic rays (with a short description of new methods of investigation) and considerations on the significance of this data with respect to the theory of the origin of cosmic rays. 184 references. (J.S.R.)

## CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

6226

METHOD OF USING A FINE-FOCUS X-RAY TUBE FOR EXAMINING THE SURFACE OF SINGLE CRYSTALS. L. G. Schulz (Univ. of Chicago). *J. Metals* 6, Sect. 2, 1082-3(1954) Sept.

A method is described in which radiation from a fine-focus x-ray tube is used to produce an image of a relatively large area of a single-crystal surface. A diagram shows the position of the x-ray source, single-crystal sample, and photographic film. (J.E.D.)

## ELECTRICAL DISCHARGE

6227

CONCENTRATION OF METASTABLE ATOMS IN THE POSITIVE COLUMN OF A LOW-PRESSURE DISCHARGE. Yu. M. Kagan and V. I. Perel. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 319-25(1953) Mar. (In Russian).

In an attempt at calculating the concentration of metastable atoms when the free path for collisions between metastable and normal atoms exceeds the radius of the tube, expressions are developed for this concentration in the positive column of a low-pressure discharge. Allowance is made for the second-kind collisions with electrons. No secure data being available so far for the cross sections of the processes of formation and decomposition of metastable atoms, the theory proposed is only compared qualitatively with experimental data obtained by Fabrikant, Butaeva, and Cirg and Kagan and Penkin. The results of comparison are satisfactory. (Science Abstracts)

## ELECTRONS

6228

THE MOTION OF ELECTRONS IN A MAGNETIC SPECTROMETER WITH NONHOMOGENEOUS FIELDS. P. P. Pavinskii. *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* 18, 175-91(1954) Mar.-Apr. (In Russian).

The calculation of the focusing of a field with surface symmetry and of a field with axial symmetry (focusing at any angle) is given. An indication is given of the method for the determination of the motion of an electron emitted at a small angle, the electron field having surface symmetry. (J.S.R.)

## 6229

PART PLAYED BY THE GRAVITATIONAL FIELD IN THE FORMATION OF THE MASS OF AN ELECTRON. Ya. I. Pugachev and M. F. Shirokov. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 375-82(1953) Apr. (In Russian).

The gravitational field of a point charge, the electromagnetic field of which is determined by equations of linear electrodynamics with higher derivatives, is investigated. As a rule, the gravitational field is found to be divergent, and both the mass  $m$  and charge  $e_0$  of the particle are introduced into the theory as integration constants independent of each other. The regular solution can only be obtained when a definite relationship exists between  $m$  and  $e_0$ . Unlike in the special theory of relativity, the mass cannot be of electromagnetic origin only. Its gravitational part is found to be  $\approx \frac{1}{2} e_0^2 k_0 / c^2$ , and cannot be neglected even in the first approximation. (Science Abstracts)

## 6230

PART PLAYED BY ELECTRONS OF THE LOWER ENERGY BANDS IN THE SECONDARY ELECTRONIC EMISSION OF METALS. A. Ya. Vyat-skin. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 429-34(1953) Apr. (In Russian).

The interaction between a primary electron with sufficient velocity and a K-level electron of Li is discussed. The K level is assumed to be the discrete level of a free Li atom. It is shown that, for Li, the part played in the total emission by the K-electrons is small compared with the contribution of lattice electrons. (Science Abstracts)

## INSTRUMENTS

### 6231

Argonne National Lab.

A CONTINUOUS FLOW pH METER FOR HIGH-PRESSURE SERVICE. W. H. Marburger, Kermit Anderson, and G. L. Wigle. July 1954. 18p. Contract W-31-109-eng-38. (ANL-5298)

A pH meter which functions at pressures up to 2000 psig and at temperatures over which the calomel-glass electrode couple will function has been devised. It is adaptable to measure the pH of dynamic systems through which high-resistivity water is flowing and can be connected to a recorder for constantly monitoring the pH of the system. (auth)

### 6232

Consolidated Vultee Aircraft Corp.

INSTRUMENT DEVELOPMENT MINIATURE LINEAR PRE-AMPLIFIER FOR USE WITH NUCLEAR DETECTORS. B. J. Huffman. Aug. 11, 1953. 23p. Contract AF33(038)-21117. (CVAC-157; FZK-9-042)

A subminiature 2-tube preamplifier circuit was developed for applications with pulse-type radiation detectors. The circuit is a conventional one-stage wide band amplifier with a cathode follower output matching a 93 ohm impedance. The gain of the circuit is 8, and ample power is available to drive 300 ft of RG 62/U coaxial cable. (K.S.)

### 6233

Consolidated Vultee Aircraft Corp.

POWER SUPPLY—MODEL NO. 9R0100A FOR A-1A PRE-AMPLIFIER. R. L. Callaway. July 10, 1953. 26p. Contract AF33(038)21117. (CVAC-158; FZK-9-043)

A power supply design is presented for specific application to the high regulation requirements of radiation detector preamplifiers. A regulated 150 volt d-c supply at 20 ma (stabilization factor of 55) is provided, in addition to an unregulated 250 volt d-c voltage at 1 ma and 6.3 volts a-c at 2 amps. (K.S.)

### 6234

School of Aviation Medicine

THE BIOLOGICAL AND MEDICAL ASPECTS OF IONIZING RADIATION. AUTOMATIC SUN TRACKING REFLECTOR AS A HEAT SOURCE. (PROJECT NUMBER 21-3501-0005, REPORT NUMBER 10). Robert M. Hodges, Everett O. Richey, and Oskar L. Ritter. June 1954. 5p. (NP-5317)

The suitability of a solar reflector for the study of flash burns is discussed. Modification of a 60-inch antiaircraft searchlight into a solar mirror is described briefly. A device for making the searchlight automatically track the sun and a high intensity heat flux meter are described in detail. (auth)

### 6235

A GENERAL-PURPOSE ELECTROMETER. R. M. Fry (Univ. of Adelaide, Australia). *J. Sci. Instr.* 31, 269-71(1954) Aug.

An instrument is described which enables absolute current measurements ( $10^{-12}$  to  $10^{-6}$  amp) to be made using the Townsend null method. It has proved satisfactory over six months of almost continuous use on free-air chamber and extrapolation chamber work. It is readily adaptable for use in a simple bridge circuit for capacitance measurement. (auth)

### 6236

A SURFACE-SCANNING PYROMETER. R. B. Sims (Davy and United Engineering Co. Ltd., Sheffield, England) and J. A. Place (British Nylon Spinners, Pontypool, England). *J. Sci. Instr.* 31, 293-4(1954) Aug.

A description is given of a laboratory prototype of a pyrometer, designed to measure at high speed the distribution of temperature over a heated body which cannot be approached sufficiently closely to use contact methods. The instrument has been calibrated against a uniformly heated surface and the brightness temperature may be measured to within  $\pm 4$  at  $1400^\circ$  K. The relationship between the current in the photomultiplier cell, used as detector, and temperature is linear, and not dependent on the inverse temperature as for ordinary vacuum photocells. (auth)

### 6237

A PEAK VOLTMETER WITH A LONG TIME CONSTANT. L. Medina (C.S.I.R.O., Sydney, Australia). *Australian J. Appl. Sci.* 5, 141-4(1954).

A peak voltmeter which retains its reading for a considerable time is described. Power frequency breakdown phenomena may be studied without distraction, and breakdown voltage read afterwards at leisure. The discharge time constant is 10,000 sec. (auth)

### 6238

THE  $\beta$ -RAY ABSORPTION SPECTRUM OF  $^{147}\text{Pm}_{61}$  AND ITS APPLICATION TO THICKNESS MEASUREMENT. L. Mandel (Imperial Chemical Industries Ltd., Welwyn, England). *Brit. J. Appl. Phys.* 5, 287-9(1954) Aug.

The absorption in aluminium of the  $\beta$  rays from  $^{147}\text{Pm}_{61}$

has been measured and found to be nearly exponential, with an absorption length of  $6.78 \text{ mg/cm}^2 \pm 3\%$ . Curves are given which relate the measuring accuracy with absorber thickness in rapid response  $\beta$ -ray gauges using  $\text{Pm}^{147}$  and  $\text{Tl}^{204}$  as sources. These show that, under the same conditions, the use of  $\text{Pm}^{147}$  leads to greater accuracy at thicknesses below about  $20 \text{ mg/cm}^2$ , and that, compared with  $\text{Tl}^{204}$ , this source could usefully extend the lower limit of thickness measurement by a factor of about 4. (auth)

## 5235

### A RAPID AND SENSITIVE RECORDING SPECTROPHOTOMETER FOR THE VISIBLE AND ULTRAVIOLET REGION.

I. DESCRIPTION AND PERFORMANCE. Chia-Chih Yang and Victor Legallais (Univ. of Pennsylvania, Philadelphia). *Rev. Sci. Instr.* **25**, 801-7(1954) Aug.

A double-beam recording spectrophotometer has been developed for rapidly obtaining spectra of labile intermediates in biochemical reactions. Light from a monochromator is split into two beams by a chopping mirror, and then the ratio of light intensities in two optical paths is measured. This ratio is expressed as percent absorption or converted electronically into units of optical density. Results are recorded on a linear wavelength scale at a maximum rate of  $6 \text{ m}\mu$  per second. A servo system corrects the nonlinearity of the wavelength scale of the quartz monochromator. The noise level corresponds to a change of optical density of  $10^{-4}$  at  $400 \text{ m}\mu$  with a spectral interval of  $3 \text{ m}\mu$ . The over-all accuracy on standard solutions (National Bureau of Standards) is about 2 percent. The air-against-air zero absorption line varies only 0.004 in optical density from 210 to  $650 \text{ m}\mu$ . (auth)

## 5240

### A RAPID AND SENSITIVE RECORDING SPECTROPHOTOMETER FOR THE VISIBLE AND ULTRAVIOLET REGION.

II. ELECTRONIC CIRCUITS. Chia-Chih Yang (Univ. of Pennsylvania, Philadelphia). *Rev. Sci. Instr.* **25**, 807-13 (1954) Aug.

The electronic photometer of a recording spectrophotometer is described in detail. Sources of error of the circuit and experimental measurements of the inherent noise of the system are discussed. A segmented diode circuit is described for converting data in absorption to units of optical density with an accuracy of better than 1 percent. The electronic circuit of the servo system to correct the nonlinearity of the wavelength scale is also described. (auth)

## 5241

HIGH-SPEED STROBOSCOPE FOR ACCELEROMETER CALIBRATION. Peter G. Sulzer, Ernest R. Smith, and Seymour Edelman (National Bureau of Standards, Washington, D. C.). *Rev. Sci. Instr.* **25**, 837-8(1954) Aug.

At low frequencies it is possible to set the movable hair-line of a filar micrometer eyepiece to the extremes of motion and determine the amplitude from a calibrated micrometer screw. At frequencies above  $800 \text{ cps}$  this method is unsatisfactory because the duration of the flash is so long that the image seen in the microscope is fuzzy, and the illumination is insufficient because a flash occurs only once for several excursions of the accelerometer. A system is described to overcome this difficulty by making the duration of the flash proportional to the length of the cycle and a very small part of the cycle and also by producing one flash for each cycle. (L.T.W.)

## 5242

### MEASUREMENT OF SPARK SPECTRUM INTENSITIES IN

THE VACUUM ULTRAVIOLET WITH THE FLUORESCENCE SENSITIZED PHOTOMULTIPLIER. S. E. Williams, M. R. Meharry, V. W. Maslen, and R. L. Falconer (Univ. of Western Australia, Nedlands). *J. Opt. Soc. Amer.* **44**, 654-8 (1954) Aug.

The fluorescence-sensitized photomultiplier has been combined with a peak-reading pulse voltmeter to record intensities from a source of the Lyman continuum operated at a repetition frequency about  $2 \text{ cps}$ . Intensities can be measured on a linear scale to within a few percent. The variation of intensity with time during the  $100 \text{ }\mu\text{sec}$  following the pulse discharge has also been examined using sodium salicylate and calcium tungstate as fluorescent materials. (auth)

## 5243

A NEW REFLECTING SPECTROGRAPH CAMERA. C. Moser (National Research Council, Ottawa, Canada). *J. Opt. Soc. Amer.* **44**, 660-3(1954) Aug.

The camera which has been developed consists of a spherical mirror and a corrector lens with spherical surfaces. The equivalent focal length is about  $900 \text{ mm}$  and the relative aperture is  $f/4$ . The design is based on the theory by Argentieri and becomes a camera of the nonconcentric type. The useful range of the camera is from  $2500 \text{ \AA}$  to  $12,000 \text{ \AA}$ . Some details of the construction and results obtained are shown. (auth)

## ISOTOPES

### 5244

OXYGEN-18 ABUNDANCE IN FRESH WATER. J. Timmermans (Univ. of Brussels, Belgium). *Nature* **174**, 234-5 (1954) July 31.

Mass spectrographic studies of the  $\text{O}^{18}$  abundance in 109 fresh-water samples obtained from various parts of the world showed very considerable variations, decreasing as the climate becomes colder. The deviations from a set standard ranged between  $+32 \times 10^{-4}$  and  $-17 \times 10^{-4} \text{ at. \%}$ . This is due, principally, to the higher  $\text{O}^{18}$  abundance in the precipitated north-bound ocean-water vapor than that of the remaining vapor. Conversely, evaporation caused a rise in  $\text{O}^{18}$  abundance in the remaining water. Experimental results and formulas are given to substantiate this. (J.A.G.)

## ISOTOPE SEPARATION

### 5245

Rensselaer Polytechnic Inst. THE DIFFUSION-DISTILLATION PROCESS FOR THE SEPARATION OF ISOTOPES. SEMI-ANNUAL REPORT. J. H. Atkins. Apr. 1, 1954. 13p. Contract AT(30-3)-52. (SO-3256).

Further experiments with the glass column diffusion-distillation equipment of C. W. Williamson (Report SO-3253) are reported. A separation of the chlorine isotopes in ethylene chlorohydrin is reported with an efficiency of only 2.0 per cent calculated on the basis of the experimental separation factor obtained. The low efficiency was attributed to an experimental difficulty, namely, a small leak in the monel cooling tube. Plans are presented for a new all-metal diffusion-distillation apparatus to be used for the separation of the isotopes of metals in the molten metal. A discussion of the anticipated advantages at this modified system is given. (For preceding reports in series see SO-3252 and SO-3253.) (auth)

## MASS SPECTROGRAPHY

6246

SPIRAL ORBIT SPECTROMETER. Giichi Iwata, Goro Miyamoto, and Masao Kotani. Translated by R. Sagane and W. Gardner from *Nippon Butsuri Gakkai Shi* 2, No. 1 (1947). 17p. (UCRL-Trans-111; AEC-Tr-1219)

General calculations concerning the orbit of the particle, intensity and resolving power, influence of the slit system, and vertical focusing for a spiral orbit spectrometer together with some calculations with respect to the  $\beta$  spectrometer are presented. (J.A.G.)

## MATHEMATICS

6247

[European Council for Nuclear Research]  
ON THE SOLUTION OF NON-LINEAR ORBIT EQUATIONS BY MEANS OF POWER SERIES EXPANSIONS. E. Regenstein. Aug. 1954. 9p. (CERN-PS/ER-38)

Solutions to nonlinear differential equations of motion which arise in describing the particle orbits of the CERN synchrotron are investigated by use of power series expansion techniques in combination with step by step integration methods to compute particular orbits. (K.S.)

6248

Institute of Rate Processes, Univ. of Utah.  
[THE WAVE MECHANICAL PROBLEM OF THREE HYDROGEN ATOMS]. TECHNICAL REPORT NO. 5. SOME QUANTUM MECHANICAL INTEGRALS. 2. TWO ELEMENTARY TWO PARAMETER INTEGRALS. (STUDIES IN APPLIED MATHEMATICS NO. 16). D. A. Baker, C. J. Thorne, R. S. Barker, and H. Eyring. Aug. 1, 1954. 25p. Contract DA-04-495-ORD-436. (NP-5310)

Numerical values are given in tabular form for several integral functions which arise in the molecular quantum mechanical formulation of the energy of a triatomic hydrogen complex. (K.S.)

6249

A CURVE ANALYZER AND GENERAL PURPOSE GRAPHICAL COMPUTER. C. S. French, George H. Towner, Donald R. Bellis, Richard M. Cook, William R. Fair, and Walter W. Holt (Carnegie Institution of Washington, Stanford, Calif.). *Rev. Sci. Instr.* 25, 765-75(1954) Aug.

A graphical computer based upon five automatic curve followers, two integrators, nine adding amplifiers, and a pen recorder was built for the transformation and combination of curves and for a simple analog computer to plot curves from equations. Heavily inked curves on 14-in. x 17-in. moving tables are tracked by photoelectric followers which continuously set potentiometers so that their output voltage is proportional to the curve height. The tables are positioned by voltages so that they may be made to move at a constant rate or may be individually controlled by some variable voltage. The follower output voltages may be transformed in various ways or combined algebraically with each other and used directly or indirectly through amplifiers to drive a recorder, a table, or an integrator. By this means curves may be changed in scale (linearly or nonlinearly) on either axis. Curves may be added, subtracted, multiplied, divided, or otherwise combined or operated upon in accordance with simple equations, and the result plotted in about a minute with an accuracy under favorable conditions of about  $\pm 0.02$  in. Complex curves can be analyzed by fitting with algebraic combinations of simpler curves. The

apparatus may be used to fit integral or differential equations to experimental data by trial adjustment of the constants. A low a-c voltage increasing linearly with time represents the independent variable; the form of the equation is determined by the way in which the various units are connected, and the values of constants are set by potentiometers. (auth)

## MEASURING INSTRUMENTS AND TECHNIQUES

6250

Washington Univ., St. Louis  
A LINEAR AMPLIFIER WITH GOOD OVERLOAD PROPERTIES AND ITS APPLICATION TO SCINTILLATION SPECTROSCOPY (thesis). Bascom Sine Deaver, Jr. Jan. 1954. 60p. (AD-26147).

6251

Brookhaven National Lab.  
GRAY WEDGE PULSE HEIGHT ANALYSIS. [PART] 2. A. W. Schardt. Jan. 1954. 20p. (BNL-237)

The design and performance of a gray-wedge pulse-height analyzer is discussed. The device employs a photographic method of pulse-height analysis equivalent to a multichannel analyzer. Pulses from a spectrometer amplifier are stretched and displayed upon an oscilloscope screen, and photographed through a gray wedge of improved design. (K.S.)

6252

Knolls Atomic Power Lab.  
FACILITIES AND INSTRUMENTATION FOR IMPROVED RESOLUTION WITH G. E. BETATRON VELOCITY SELECTOR. M. L. Yeater, E. R. Gaertner, and W. J. McRoberts. June 4, 1954. 27p. Contract W-31-109-Eng-52. (KAPL-1108)

A resolution of approximately 0.04 microsecond per meter has been achieved with the General Electric betatron neutron velocity selector by installation of equipment for a twenty-meter flight path. New facilities, instrumentation, and preliminary results are described. Tests made so far have involved operation of betatron and timing equipment as employed in previous operations. These are now modified in order to improve further the resolution and operating efficiency. (auth)

6253

University of Southern Calif.  
INVESTIGATION OF CHEMICAL CLOUD CHAMBERS. Richard E. Vollrath. July 1954. 20p. Contract DA-04-495-Ord-282. (NP-5305)

Investigations of nucleation processes involving multi-component systems, condensation of salt solution droplets, and the photochemical formation of condensable vapors are reported which were carried out in an effort to develop a continuous cloud chamber. (C.H.)

6254

School of Aviation Medicine  
A CONSTANT AIR MONITOR FOR ALPHA-EMITTING ISOTOPES. (PROJECT NO. 21-3501-0003, REPORT NO. 7). John A. Auxier, Univ. of Texas and Air Force Radiobiology Lab; and Walter Blakey, School of Aviation Medicine. 8p. (NP-5316)

A dependable instrument was constructed and tested for monitoring air for  $\alpha$  contamination. An air-filled proportional counter, pulse amplifier, alarm unit, and power supplies were assembled in such a manner as to operate satisfactorily. (SAM abst.)

## 6255

A SPECTROMETER FOR FAST NEUTRONS AND THE NEUTRON SPECTRUM OF  $\text{Ra-}\alpha + \text{Be}$  (thesis). Ulrich Schmidt-Rohr. Translated by Henry Kramer from *Z. Naturforsch.* 8a, 470-9(1953). 19p. (UCRL-Trans-187)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-6167.

## 6256

A VIEW POINT ON THE MEASUREMENT OF RADIUM AND RADIO-COBALT RADIATION WITH THE CADMIUM SULFIDE CRYSTAL PROBE. Albrecht Reuss, Rolf Plesch, Ursula Mayer, and Corneli v. Muschwitz (Universitäts-Frauenklinik Erlangen, Germany). *Strahlentherapie* 94, No. 3, 384-92(1954). (In German).

The use of a CdS crystal probe in a 0.25-mm aluminum tube for the purpose of measuring, in a water phantom, the rays emitted by radium and by cobalt is discussed. When increasing the distances of the preparations, considerably higher values were found, as compared to those measured in the air ionization chamber. These deviations can be avoided by using a 0.4-mm gold tube instead of the aluminum tube. This also means that the crystal probe will possess the same sensitivity toward radium and toward radiocobalt. The CdS probe in a gold tube can thus be used with one and the same calibration for measuring the intensities of both radium and cobalt rays in air as well as in the phantom. (auth)

## 6257

INVESTIGATIONS ON THE APPLICABILITY OF CADMIUM SULFIDE CRYSTALS TO DOSAGE DETERMINATIONS IN THE X- AND  $\gamma$ -RAY RANGE. Alfred Schaal (Röntgen-Mebstelle der Siemens-Reiniger-Werke AG, Erlangen, Germany). *Strahlentherapie* 94, No. 3, 393-402(1954). (In German).

The magnitudes that are of importance for the dosimetric use of CdS crystals, namely, such magnitudes as the dependence of the wave length and of the direction, were experimentally determined and theoretically worked out in the hard-ray range of half value layers from 2 to 47 mm aluminum. The results make evident that in practical application, it is imperative to know the quality of the radiation that is falling on the crystal which can be assumed to be the case for measurements in air. As regards measurements in the phantom, the hardness of the scattered radiation has to be taken into account. This pertains particularly to hard rays. (auth)

## 6258

A MOLECULAR PRODUCT DOSIMETER FOR IONIZING RADIATIONS. Edwin J. Hart and P. D. Walsh (Argonne National Lab., Lemont, Ill.). *Radiation Research* 1, 342-6(1954) Aug.

A modification of the ferrous sulfate dosimeter is described which employs a mixture of ferrous and cupric sulfates in sulfuric acid and in which the net reaction observed is only that due to hydrogen peroxide formed along the particle track. Data obtained using this dosimeter for measurements of  $\text{Co}^{60}$   $\gamma$  radiation and the recoil products of the  $\text{B}^{10}$  ( $\alpha, n$ )  $\text{Li}^7$  nuclear reaction are compared with data obtained using the standard ferrous sulfate dosimeter. (C.H.)

## 6259

A VOLTAGE REGULATOR SYSTEM FOR STABILIZATION OF FIELD CURRENT OF A SOLENOIDAL BETA-RAY SPECTROMETER. J. Mahanty and A. N. Prasad (National Physical Lab. of India, New Delhi). *J. Sci. Ind. Research (India)* 13, 461-3(1954) July.

An experimental procedure for stabilizing the magnetizing current in a beta-ray spectrometer, using an electronically regulated d.c. generator, is described. (auth)

## 6260

THALLIUM AS A REFERENCE STANDARD FOR BETA RADIOACTIVITY. A. G. Wheler, Jr., S. A. Reynolds, and W. A. Brooksbank, Jr. (Oak Ridge National Lab., Tenn.). *J. Am. Water Works Assoc.* 46, 79-81(1954) Jan.

A standardized method of beta counting, such as the  $\text{Tl}^{204}$  method, will prove useful in background surveys on streams, in checking higher levels of activity in water, and in radioactive waste disposal. The procedure has the merit of referring radioassays to a standard that will have meaning in the future when better methods are available. By making all background surveys referable to one another, such standardized surveys would indicate how the background in streams is changing with time and whether a potential health hazard is developing. (auth)

## 6261

A NOTE ON THE USE OF QUENCHING CIRCUITS WITH GEIGER-MÜLLER COUNTERS. R. L. Gordon (Safety in Mines Research Establishment, Sheffield, England). *J. Sci. Instr.* 31, 306(1954) Aug.

It is pointed out that the introduction of a diode as a d-c restorer in the quenching circuit of a Geiger tube will eliminate the errors introduced at high counting rates due to the high acquired potential of the central counter wire when capacitively coupled to the quenching circuit preamplifier. (K.S.)

## 6262

THE RESPONSE OF A SODIUM IODIDE SCINTILLATION COUNTER TO 18 MEV  $\gamma$ -RADIATION. J. G. Campbell and A. J. F. Boyle (Univ. of Melbourne, Australia). *Australian J. Phys.* 7, 284-7(1954) June.

The probability distribution of ionization energy in a sodium iodide crystal 2.5 cm long by 2.5 cm diameter due to the absorption of 18 Mev quanta has been calculated, taking account of side escape of electrons from the crystal due to multiple scattering. The results confirm the conclusions of the authors' earlier work. (auth)

## 6263

THE MEASUREMENT AND REDUCTION OF DISTORTION IN THICK EMULSIONS. V. D. Hopper, Y. K. Lim, and Madeline C. Walters (Univ. of Melbourne, Australia). *Australian J. Phys.* 7, 288-96(1954) June.

A study has been made of some of the factors influencing the distortion of developed images of tracks in Ilford G5 400 $\mu$  emulsions. It has been found that the effect of distortion on scattering measurements can be reduced to a negligible amount by developing the emulsions at 15°C and drying with an alcohol-water solution of increasing concentration. A simple quantitative description of the distortion can be obtained by fitting a sinusoidal series to the curve of a high-energy track traversing the emulsion. (auth)

## 6264

SCINTILLATION SPECTROMETERS FOR MEASURING THE TOTAL ENERGY OF X-RAY PHOTONS. R. S. Foote and H. W. Koch (National Bureau of Standards, Washington, D. C.). *Rev. Sci. Instr.* 25, 746-58(1954) Aug.

X-ray spectrometers are described that operate on the principle of totally absorbing the energy of an individual x-ray photon in a scintillator. Experiments with scintillators of xylene containing terphenyl, and of sodium iodide activated

by thallium, show that detection efficiencies better than 80 percent and energy resolutions better than 10 percent are attainable in the x-ray energy range from  $\frac{1}{2}$  to 50 Mev. Monte Carlo calculations and crude scaling laws that simplified extrapolations to other size scintillators are discussed. (auth)

**6265**

MEASUREMENT OF ( $p, \gamma$ ) COINCIDENCES EMPLOYING TIME OF FLIGHT. W. T. Joyner and H. W. Lewis (Duke Univ., Durham, N. C.). Rev. Sci. Instr. **25**, 828-9(1954) Aug.

A time of-flight method, with time resolution of the order of  $10^{-8}$ , is described for the measurement of coincidences between incident proton and emitted  $\gamma$  in inelastic scattering. The instrument is shown and described, together with data from inelastic scattering of protons from Al. (L.T.W.)

**6266**

IMPROVED METHOD FOR STANDARDIZING HIGH VOLTAGE FOR SCINTILLATION DETECTORS. P. W. Reinhardt and F. J. Davis (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr. **25**, 829-30(1954) Aug.

A system for standardizing a high voltage from power supplies which deliver as little as 10  $\mu$ a is described. It can be easily incorporated into any equipment using one or more stages of linear pulse amplification with amplitude discrimination. The system employs a simplified version of the Hg relay pulse generator. (L.T.W.)

**6267**

INSTABILITY IN METHYLAL QUENCHED X-RAY DETECTORS. S. Fine and C. F. Hendee (Philips Labs., Inc., Irvington-on-Hudson, N. Y.). Rev. Sci. Instr. **25**, 830(1954) Aug.

A long time instability in this type of tube was observed in the nature of an intermittent violent current fluctuation, sometimes appearing only after several hours of continuous operation. Light flashes were detected in the vicinity of the glass and mica surfaces, coincident with the current fluctuations. The instability seemed to have some correlation with a high photosensitivity. The photosensitivity was eliminated by sparking the tube shell in Br vapor prior to filling. The spurious discharges were completely eliminated by adding trace amounts of methylene bromide to the gas filling. Reasons for instability are discussed. (L.T.W.)

**6268**

NOTE ON THE LOADING OF PHOTOGRAPHIC EMULSIONS WITH WIRES. A. H. Morrish (McGill Univ., Montreal, Canada). Rev. Sci. Instr. **25**, 831-4(1954) Aug.

Various aspects of the wire-loading technique for nuclear emulsions are discussed. (L.T.W.)

**6269**

ON THE EFFICIENCY OF QUANTA DETECTION IN PROPORTIONAL COUNTERS. A. Bisi and L. Zappa (Istituto di Fisica Sperimentale del Politecnico, Milan, Italy). Nuovo cimento (9) **12**, 211-16(1954) Aug. (In English)

For the determination of the efficiency of quanta detection in proportional counters, integrals have been deduced and tabulated for some special geometrical arrangements; an experimental investigation of the wall effect in argon has been carried out for quanta of energies up to 50 kev. (auth)

**6270**

INTRODUCTION OF FINE PARTICLES OF A SUBSTANCE INTO THE EMULSION OF THE THICK-EMULSION PHOTOGRAPHIC PLATES. Zh. S. Takibaev. Zhur. Eksptl'. i Teoret. Fiz. **24**, 229-32(1953) Feb. (In Russian).

For investigation of the interaction of cosmic rays with the nuclei of different atoms, the author suggests introducing fine spheroidal particles of the respective substance, obtained by electric sparking, and discusses several methods of doing it. (Science Abstracts)

**6271**

INSERTION OF A THIN FILAMENT INTO A PHOTOGRAPHIC EMULSION FOR THE PURPOSE OF INVESTIGATING NUCLEAR FISSION. Zh. S. Takibaev. Zhur. Eksptl'. i Teoret. Fiz. **24**, 233-6(1953) Feb. (In Russian).

Instead of sandwiching a metal foil between two emulsions the author uses a thin (30-50 $\mu$ ) metal filament which is removed before the chemical treatment of the plate. The scanning is done along the face of the filament. (Science Abstracts)

**6272**

METHOD OF INSERTING THIN FILAMENTS INTO THICK-EMULSION PHOTOGRAPHIC PLATES. O. N. Miller and A. A. Sirotinskaya. Zhur. Eksptl'. i Teoret. Fiz. **24**, 237-9(1953) (In Russian).

A technique is described for inserting thin (10 and 30  $\mu$ ) W wires between two emulsion layers. The deformation in the emulsion, due to indentation by the filament, does not extend beyond 20  $\mu$  for 10  $\mu$  filaments. (Science Abstracts)

**6273**

DETERMINATION OF THE EXACT MOMENT WHEN CHARGED PARTICLES ARE RECORDED IN A PHOTOGRAPHIC PLATE. Zh. S. Takibaev. Zhur. Eksptl'. i Teoret. Fiz. **24**, 363-4(1953) Mar. (In Russian).

The suggested method consists in placing two plates with emulsions turned toward each other, the lower plate beginning to rotate slowly at a moment  $T_0$ . After one full rotation, the clockwork mechanism displaces the upper plate by  $\Delta r$ . This rotation with superposed displacements lasts until time  $T$ . Any moment  $t$  (between  $T_0$  and  $T$ ) can be obtained from the equation  $T-t = (1 + \frac{\varphi + \varphi_0}{2\pi})/\omega$ , where  $l$  is the

number of displacements,  $\varphi_0$  and  $\varphi$  are azimuths of the track in the upper and lower plate, respectively, and  $\omega$  is the angular speed of rotation. (Science Abstracts)

**6274**

SCINTILLATION DETECTORS IN MEDICAL AND BIOLOGICAL RESEARCH I. E. H. Belcher. Atomics **5**, 219-23, 228(1954) Aug.

Among the characteristics of the scintillation detector is its high sensitivity to x and  $\gamma$  radiation, and it is this latter characteristic which gives rise to its widespread application to radioactive tracer studies in medical and biological science. Counting and d-c measurement techniques, counters for the assay of biological samples, sample counting by solution in liquid scintillating media, and annular sample and well-type scintillation counters are discussed. (auth)

**MESONS**

**6275**

DELAYED DISINTEGRATION OF HEAVY FRAGMENTS. Francoise A. Brisbout and V. D. Hopper (Univ. of Melbourne, Australia). Australian J. Phys. **7**, 353-8(1954) June.

Two examples of delayed disintegration of heavy fragments are discussed. In one case the delayed disintegration of a heavy fragment ( $Z = 3$ ) emitted from a star produced another star after traversing 370 $\mu$  of an Ilford G 5 emulsion.

In the second case, a heavy fragment ( $Z = 2$ ) is emitted from a star and produces another before it reaches the end of its range in the emulsion. The lifetimes of these fragments have been estimated as  $\approx 9 \times 10^{-12}$  and  $6 \times 10^{-12}$  sec. (K.S.)

## 6276

ON THE  $\chi$ - $\mu$  DECAY-IN-FLIGHT IN THE PHOTOGRAPHIC EMULSION EXPOSED AT HIGH ALTITUDE. Kiyosi Niu (Nagoya Univ., Japan). *Progr. Theoret. Phys. (Japan)* **11**, 499-500(1954) Apr.-May.

A meson star event in an Ilford G-5 emulsion is interpreted as  $\chi$ - $\mu$  decay in flight. (K.S.)

## 6277

NUCLEAR ABSORPTION OF NEGATIVE K PARTICLES.

Herbert DeStaebler, Jr. (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **95**, 1110-11(1954) Aug. 15.

Three events occurring in a multiplate cloud chamber are interpreted as the nuclear absorption of  $K^-$  particles according to the processes  $K^- + n \rightarrow \Lambda^0 + \pi^-$  and  $K^- + p \rightarrow \Lambda^0 + \pi^0$ . General features of the decay processes are discussed. (K.S.)

## 6278

A NEW VARIANT OF EQUATIONS OF THE MESON VECTOR THEORY. N. S. Kalitsin. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, 293-8(1953) Mar. (In Russian).

Equations derived for meson vector field in a five-dimensional space are used for calculating the potential of nuclear forces. Suitable choice of constants eliminates, in the nonrelativistic approximation, the singular dipole potential of the  $1/r^3$  form. The final equation for the potential energy of interaction between two nucleons across a mesonic field is invariant with respect to an inversion of the system of coordinates and to the interchange of the positions of the nucleons. (Science Abstracts)

## MICROWAVES

### 6279

A HIGH-TEMPERATURE MICROWAVE SPECTROMETER.

M. L. Stitch, A. Honig, and C. H. Townes (Columbia Univ., New York). *Rev. Sci. Instr.* **25**, 759-64(1954) Aug.

A spectrometer for measurement of microwave absorption by gases at temperatures as high as 1000°C is described. Microwaves pass through a 5-ft nickel absorption cell. Absorption lines are modulated by Stark effect to give sensitive detection. The spectrometer has been used to study spectral lines of some alkali halides and several other high boiling point diatomic molecules between 300 and 775°C. (auth)

### 6280

APPARATUS FOR MICROWAVE SPECTROSCOPY. M. W.

P. Strandberg, H. R. Johnson, and J. R. Eshbach (Massachusetts Inst. of Tech., Cambridge). *Rev. Sci. Instr.* **25**, 776-92(1954) Aug.

Design considerations are presented for a video microwave spectrograph using Stark modulation and a crystal or bolometer detector. Crystal and source noise is explicitly included in the treatment. A detailed description of some of the equipment in use in the laboratory is given. Some of the advantages and disadvantages of other systems are mentioned. (auth)

## MOLECULAR PROPERTIES

### 6281

Solid-State and Molecular Theory Group. Mass. Inst. of Tech. QUARTERLY PROGRESS REPORT NO. 13. July 15,

1954. 65p. Contract N5ori-07856. (NP-5309)

Configuration interaction theory in the solid state is treated in detail, with particular reference to the one-electron approximation in the quantum theory of atoms, molecules, and crystals. A review of work to date indicates that there is no way of avoiding the labor of a configuration interaction calculation as demonstrated by the extensive work required for an acceptable solution to the simple benzene problem. The results of this calculation, using valence bond and molecular orbit theory, are given for the benzene electron levels. Further applications of the augmented plane wave method to electron energy bands in Cu and graphite have been made, and a procedure is suggested for speeding the convergence at symmetry points in reciprocal space. A summary of a calculation is presented on the magnetic scattering of slow neutrons by  $O_2$ . (For preceding period see NP-5172.) (K.S.)

### 6282

POLARIZATION OF THE FLUORESCENCE OF ORGANIC CRYSTALS. N. D. Zhevandrov. Translated from *Doklady Akad. Nauk S.S.S.R.* **83**, 677-80(1953). 7p. (UCRL-Trans-182).

The degree of polarization of fluorescence radiation from crystals of aromatic hydrocarbons was studied for the purpose of investigating the orientation of molecules in the lattice and also for the determination of molecular anisotropy. Fifteen compounds were studied, including  $UO_2SO_4$ . (K.S.)

### 6283

PARAMAGNETIC RESONANCE ABSORPTION IN SODIUM

PLUTONYL ACETATE. Clyde A. Hutchison, Jr., and W. Burton Lewis (Univ. of Chicago and Univ. of California, Los Alamos, N. M.). *Phys. Rev.* **95**, 1096(1954) Aug. 15.

Paramagnetic resonance absorption in pure single crystals of  $NaPuO_2(C_2H_3O_2)_3$  at 4°K was observed at a frequency of  $2.3 \times 10^{10}$ /sec. The magnetic field was varied from 0 to  $1.4 \times 10^4$  gauss. Three crystals were measured, each rotated about the 112, 111, and 100 axes. Observations were made of peak positions for 21 different orientations of the  $PuO_2^{++}$  axis ranging from  $\theta = 0.108$  to 0.425. The resonance data indicate that the two unpaired electrons in the plutonyl compound are electrons. (K.S.)

## NUCLEAR PHYSICS

### 6284

Purdue Univ.

LINEAR ELECTRON ACCELERATOR. PROGRESS REPORT NO. 4. June 15, 1954. 18p. Contract AT(11-1)-121. (COO-166)

General studies on the excitation of nuclear isomers was continued. Penetration characteristics of 2.2-Mev electrons were investigated by scattering and path-length data from nuclear emulsions. (For preceding period see COO-165.) (K.S.)

### 6285

ON A SIMPLE IMAGE OF THE PHENOMENA OF NUCLEAR FISSION. Daniel Curie. Translated by S. Shewchuck from *Compt. rend.* **235**, 1286-8(1952). 4p. (UCRL-Trans-165)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-1216.

## NUCLEAR PROPERTIES

### 6286

REGULARITY IN MAGNETIC MOMENTS OF ODD NUCLEI.

Morris F. Scharff (Univ. of Chicago). *Phys. Rev.* **95**, 1112-13(1954) Aug. 15.

A regularity has been observed between the magnetic moment of an odd-even nucleus ( $Z, N$ ) and that of the nucleus ( $Z + 2, N + 2$ ). The following rule is formulated: addition of an  $\alpha$  particle to an odd nucleus pushes its magnetic moment toward the Schmidt line, if the spin of the heavier nucleus is given by  $I = 1 - \frac{1}{2}$ , and away from the Schmidt line if the spin of the heavier nucleus is given by  $I = 1 + \frac{1}{2}$ . The regularity is demonstrated in 41 out of 49 cases where magnetic moments were experimentally known. (K.S.)

6237

MOMENTS OF  $\text{Na}^{23}$ . Morris F. Scharff (Univ. of Chicago). *Phys. Rev.* **95**, 1114(1954) Aug. 15.

It is shown that a  $(d_{5/2})^3$  configuration of the odd protons in  $\text{Na}^{23}$ , with a resultant spin  $I = \frac{3}{2}$  in the  $jj$  coupling scheme, can be theoretically formulated in agreement with experimental values of the magnetic dipole and electric quadrupole moments. (K.S.)

6288

A NEW METHOD FOR DETERMINATION OF THE  $\text{Be}^8$  LEVELS. H. Glättli, E. Leopfe, and P. Scherrer (E. T. H., Zürich, Switzerland). *Nuovo cimento* (9) **12**, 174-90(1954) Aug. (In German).

Excited  $\text{C}^{12}$  nuclei decay into 3  $\alpha$  particles. At known excitation energies, the observation of the frequency of starforms leads to conclusions of the  $\text{Be}^8$  levels without the necessity of measuring the energy of the  $\alpha$  particles. The energy of the  $\text{Be}^8$  levels can be resolved to a 0.05 half width. The levels scanned had even total spin and even parity. Conclusions were made on the transition probability in the  $\text{B}^{11}(\text{p}, \alpha)\text{Be}^{8*}$  process. By observation of the angular correlation of  $\text{Be}^8$  decay particles/ $\text{Be}^8$  line of flight, the life of the  $\text{Be}^8$  intermediate nuclei can be estimated. The observation of the angular distribution of the first emitted  $\alpha$  particle, which can be determined unambiguously, yields expressions for the total spin of the  $\text{Be}^8$  levels. (tr-auth)

6289

THE ABSOLUTE VALUE OF THE RESONANCE INTEGRAL OF GOLD. Dragoslav Popović (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). *Z. Naturforsch.* **9**, 600-2(1954) July-Aug. (In German).

By comparison of the "Cd ratio" for the activation of Au with that for the absorption by B, the resonance integral of Au was found to be  $R = \int_{0.5 \text{ ev}}^{\infty} \sigma_{\text{res}} dE = 1326 \pm 15$  barns. (tr-auth)

6290

ANALOGOUS STATES IN HEAVY ISOBARIC NUCLEI. V. S. Shpinel. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, 90-2(1953) Jan. (In Russian).

Levels are compared in pairs of odd-number isobaric nuclei, the  $Z$  values of which differ by 2 units. It is possible to deduce from the available literature the occurrence of states which can be looked upon as analogous. The excitation energies for analogous states are almost identical if the number of the neutrons is odd, whereas for the case of odd-number protons the excitation energy is less for the isobar with a greater  $Z$  value. It is suggested that this behavior is due to the Coulombic interaction of the off number nucleon. (Science Abstracts)

6291

SOME SINGULARITIES IN THE DISTRIBUTION OF THE ISOTOPES OF ATOMIC NUCLEI. V. I. Mamasakhlisov.

*Zhur. Eksptl'. i Teoret. Fiz.* **24**, 190-6(1953) Feb. (In Russian).

The question of the existence of  $\alpha$ -particles in the nuclei is reconsidered in the light of recent data on the collisions of fast particles with the nucleus, pointing to the possibility of existence of the individual nucleus parts. The known facts—viz. that, beyond  $N$ , (1) nuclei with an odd  $Z$  (atomic number) have either one stable isotope or, at most, two such isotopes differing by 2 neutrons, and (2) all nuclei with an odd charge have an odd mass number, whereas those with an even charge have both the even and odd mass numbers—are given a tentative explanation based on the assumption that, when the addition of a nucleon to a stable nucleus is accompanied by the known processes  $\beta^+$ ,  $\beta^-$  or  $K$ -capture, an internal change of structure, accompanied by the formation of  $\alpha$ -particles, can take place in the nucleus. The existence of adjacent isotopes for  $\text{Li}$ ,  $\text{B}$  and  $\text{N}$ , and their absence for  $\text{F}^{19}$  onwards, find also an explanation, as well as the fact that, in a system of stable isotopes with even  $Z$ , those isotopes are absent that would be obtained from the ( $Z-1$ ) nuclei by the  $n \rightarrow p$  change. The proposed model of the distribution of the neutron and proton states tallies with data available for the known stable isotopes. (Science Abstracts)

6292

ROTATION LEVELS AND SPECTRA OF HEAVY NUCLEI. S. G. Ryzhanov. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, 361-2(1953) Mar. (In Russian).

A mathematical basis for the idea that the 3 different values of the rotation constant (15, 20, and 26.5 kev) are related to nuclear shells is given. (Science Abstracts)

6293

FURTHER COMMENTS ON THE PROPOSED MASS SPECTRUM. Sadae Yoshikawa and Tomimaro Hasebe (Hitachi Ltd., Katsuta-cho, Ibaragi-ken, Japan). *Progr. Theoret. Phys. (Japan)* **11**, 496-8(1954) Apr.-May. (cf. NSA 8-2001)

6294

CONFIGURATION MIXING AND MAGNETIC MOMENTS OF NUCLEI. Akito Arima and Hisashi Horie (Univ. of Tokyo, Japan). *Progr. Theoret. Phys. (Japan)* **11**, 509-11(1954) Apr.-May.

6295

ORIENTATION OF NUCLEI. G. R. Khutsishvili. *Uspekhi Fiz. Nauk* **53**, 381-412(1954) July. (In Russian).

In the first part of the present work the methods by which orientation in nuclei is produced are discussed. In the second part the experiments which are made with oriented nuclei are described. The knowledge obtained from these experiments is discussed. 49 references. (J.S.R.)

## NUCLEAR REACTORS

6296

OPERATIONAL CHARACTERISTICS OF A HEAVY-WATER REACTOR. Arne Lundby (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). *NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12*, 1-5(1954).

The time behavior of a heavy-water-moderated reactor differs from that of a graphite reactor in two ways. Firstly, the prompt and delayed photoneutrons released in the heavy water will influence the inhour equation and the reactor transfer function. In a reactor operated partly for producing

isotopes and partly at lower power levels for reactor oscillator as well as for danger coefficient experiments, the perturbations due to the photoneutrons are particularly noticeable. The sources of the high-energy gamma rays producing the photoneutrons and their effect on the experiments are analyzed. Furthermore it is shown how high-energy gamma-ray emitters can be investigated by introducing the samples in the reactor and measuring the effects on the reactivity. Secondly, the large negative temperature coefficient of the heavy water ( $-2.5 \times 10^{-4}/^{\circ}\text{C}$ ) will greatly contribute to the stabilization of this type of reactor. This is demonstrated in kinetic experiments with the Kjeller reactor JEEP, for which other thermal characteristics are also presented. (auth)

**5297**

MEASUREMENT OF THE DIFFUSION LENGTH OF THERMAL NEUTRONS IN GRAPHITE. José García Fité (Junta de Energía Nuclear, Madrid, Spain). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 11-15(1954)

A method is described to determine the diffusion length of thermal neutrons in graphite. The graphite pile is composed of a cylinder 130 cm high and 100 cm in diam. surrounded by a reflecting medium, in this case, paraffin. Measurements inside it are carried out under the following conditions: placing an aluminum coat between graphite and the reflecting medium and placing a cadmium coat between graphite and the reflecting medium. The difference is the neutron distribution which could be obtained at the graphite cylinder if a distributed thermal neutron source existed at its lateral surface. (auth)

**5298**

NONUNIFORM FUEL DISTRIBUTIONS IN NUCLEAR REACTORS. G. Goertzel and William A. Loeb (Nuclear Development Associates, Inc., White Plains, N. Y.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 82-7(1954).

In the majority of reactor designs the materials are distributed in a uniform pattern within the reactor. This uniform material distribution seldom results in a desirable distribution of other important performance parameters such as critical mass, heat generation, or coolant temperature rise. It is pointed out that rather appreciable advantages may be gained by a deliberate redistribution of fuel, coolant, moderator, or poison materials. Three examples are given: a fast reactor with uniform power generation per coolant passage, a thermal reactor with uniform power generation per unit mass of fuel, and a thermal reactor with uniform power generation per unit volume of core. Methods for calculating the requisite fuel distributions are indicated. The resulting fuel distributions are shown. (auth)

**5299**

CALCULATION OF THE CHARACTERISTIC FACTORS OF A URANIUM-GRAPHITE LATTICE. R. Ortiz Fornaguera, A. Carbó, and T. Iglesias (Junta de Energía Nuclear, Madrid, Spain). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 88-95(1954).

The methods followed in computing the characteristic factors  $f$  and  $p$  of a uranium-graphite lattice and results obtained are presented. Theoretical methods for computing the factors  $f$  and  $p$ , methods of numerical calculus followed in practice, and the estimate of the errors involved are given. The results obtained for two kinds of graphite of the same degree of purity but of different densities, 1.6 and 2.0, are tabulated. (auth)

**5300**

APPLICATION OF ANALOG COMPUTING TECHNIQUES TO REACTOR DYNAMIC ANALYSIS. J. C. Moise (Pratt and Whitney Aircraft, East Hartford, Conn.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 96-106(1954).

Dynamic analysis of a power-producing nuclear reactor involves solution of both the reactor kinetic equations and the thermodynamic, hydrodynamic, and mechanical equations describing the dynamics of all system components which influence the nuclear behavior of the reactor. The nonnuclear equations include those describing the behavior of materials within the reactor core and those describing the dynamics of external system components which are coupled to the reactor through the flow of a heat transfer fluid. Typical components of such an external system are heat exchangers, pumps, transmission lines, and turbines. Since the complete system is of high order and nonlinear, hand solution of the resulting equations is extremely time consuming if not impossible. This paper describes the application of an analog computer to the solution of such a system and discusses the information which can readily be obtained from this type of work. (auth)

**5301**

LIQUID-FUEL REACTORS WITH URANIUM OXIDES. J. J. Went and H. De Bruyn (Netherlands Reactor Committee). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 120-6(1954).

Operational details are given for liquid-fuel reactors in which suspensions of uranium oxide in heavy water or fluidized uranium oxide are applied. In liquid suspension reactors the stability, the rate of settling, and the fluidity of the suspensions, as well as the pumping methods, are important. Flow schemes of a homogeneous and a heterogeneous reactor are described and discussed. With gaseous suspensions the fluidization, the homogenization, and the regulation of the fuel transport inside the reactor, as well as the pneumatic transport outside the reactor, are important. A flow scheme of a high-temperature heterogeneous reactor is described. (auth)

**5302**

SELECTION OF OPTIMUM TEMPERATURE CONDITIONS IN POWER REACTORS AND THEIR HEAT-EXCHANGER SYSTEMS. Charles H. Robbins (North American Aviation, Inc., Downey, Calif.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 181-200(1954).

Optimum temperature conditions in a reactor power plant are considered to be those leading to the production of electric power by a base-load plant at the lowest possible cost. Temperature conditions of primary concern are the temperature of the reactor coolant, temperature differences in the heat exchangers, and the pressure and temperature of the steam for the power cycle. (L.T.W.)

**5303**

USE OF THE IONIZATION POWER OF NUCLEAR REACTORS FOR PROFITABLE CHEMICAL PROCESSES. Bernard Manowitz (Brookhaven National Lab., Upton, N. Y.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 201-7(1954).

Nuclear reactors can be considered as a source of ionization power and hence as a vehicle for rupturing chemical bonds and initiating chemical reactions via ionic or free-radical mechanisms. An economic analysis indicates that it may be justifiable to build small nuclear reactors especially for producing chemicals with high price differentials

between raw material and product or for producing chemical products having improved or new properties. For certain chemical processes it would be desirable to have a neutron-free ionization field. This can be accomplished by using a rapidly circulating liquid fuel, separating out the gaseous fission products immediately after the core, and transferring them to an irradiation chamber. For chemical transformation in which neutron fields can be tolerated, the ionization power of the fission fragments themselves may be altered by making the raw material for the chemical reaction the moderator for the reactor. Specific designs for reactors of these types are discussed. (auth)

### 6304

ECONOMIC POWER FROM FAST BREEDER REACTORS? C. A. Reunie (Atomic Energy Research Establishment, Harwell, Berks, England). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 222-27(1954).

The role of fast breeder reactors in a nuclear power program is discussed. It is concluded that a balanced scheme of fast reactors which produce more fissile material than they consume, and thermal reactors which are not quite self-sustained in fissile material offer an attractive line of development for a country without large reserves of uranium, since in this way it should be possible to utilize an appreciable fraction of the source material for power generation. The influence of reactor costs and processing costs on the price of electrical power is discussed, and some estimate is made of the allowable costs in such a system. A value can be assigned to the fissile material once the other costs are known, and this would enable comparisons to be made with other schemes for generating electrical power from nuclear fuels. (auth)

### 6305

THE COOLING SYSTEM OF THE SACLAY PILE. M. Goldschmidt and F. Perrin (Commissariat à l'Énergie Atomique, Paris, France). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 243(1954).

The cooling system of the Saclay Reactor uses a compressed gas in a closed circuit. Each U rod is surrounded by double Al tubing. The outside tube, submerged in  $D_2O$ , is thick enough to withstand the pressure of the gas. The cool compressed gas is admitted at the top between the outside and inside tubes, flows down to the bottom, and goes up in the annular space between the intermediary tube and U rod. Characteristics and operation of this system are discussed. (L.T.W.)

### 6306

APPROXIMATIONS ON THE KINETIC BEHAVIOR OF FAST REACTORS. Richard A. Fayram and Karl Bernstein (Univ. of California, Berkeley and Los Angeles). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 244-59(1954).

Kinetic equations for fast reactor behavior, delayed neutron yields for  $Pu^{239}$  and  $U^{235}$ , neutron cross sections, motion of fuel and reflector elements for control, temperature effects on reactivity, and time-dependent reactivity changes are discussed and evaluated. Generalized systems are treated in an elementary way, with attention given to the effects of physical characteristics, design variables, and characteristics which are to some extent both operationally controllable and inherent in a given system. Some calculated results based on representative data are given.

The discussion suggests means of making preliminary, rapid, and approximate evaluation of the kinetic behavior of fast reactor systems. (L.T.W.)

### 6307

THE PROBLEM OF REMOVING THE THERMAL ENERGY OF NUCLEAR REACTORS. G. Franco. Energia Nucleare, No. 6, 135-42(1953) Feb. 20. (In Italian).

Some new aspects of the problem of removing the thermal energy of nuclear reactors are discussed, and the solutions adopted are shown. (J.S.R.)

### 6308

THE CONTROL OF A THERMAL NUCLEAR REACTOR. S. Barabaschi. Energia Nucleare, No. 6, 143-8(1953) Feb. 20. (In Italian).

The problem of the regulation and control of a nuclear reactor is presented schematically. (J.S.R.)

### 6309

ELECTRONIC SIMULATORS OF NUCLEAR REACTORS. Emilio Gatti. Energia Nucleare, No. 7, 155-60(1953) May 30. (In Italian).

The fundamentals of an electronic simulator in general and of reactor simulators in particular are summarized. (J.S.R.)

## NUCLEAR TRANSFORMATION

### 6310

Los Alamos Scientific Lab. SEARCH FOR THE REACTION  $T(d,\gamma)He^5$ . George A. Sawyer and Louis C. Burkhardt. Aug. 24, 1954. 10p. Contract W-7405-eng-36. (LA-1695).

An attempt was made to detect the reaction  $T(d,\gamma)He^5$  using a 250-keV Cockcroft-Walton accelerator. A tritium-zirconium target was bombarded with 160-keV deuterons and a NaI scintillation counter was used to search for 16-MeV rays from the  $T(d,\gamma)He^5$  reaction. No 16-MeV gamma-ray was detected. This is consistent with a cross section less than 0.5 mb at 160 keV. (auth)

### 6311

ANGULAR DISTRIBUTIONS IN THE  $^{10}B(d,p)^{11}B$  REACTION. N. T. S. Evans and W. C. Parkinson (Cavendish Lab., Cambridge, England). Proc. Phys. Soc. (London) A67, 684-94(1954) Aug.

Angular distributions of six proton groups from the reaction  $B^{10}(d,p)B^{11}$  were obtained using a scintillation counter spectrometer and an incident deuteron energy of 7.7 MeV. Distributions for the three longest range groups were also obtained at the additional deuteron energies of 6.2, 7.1, and 8.0 MeV. The results are largely compatible with the normal theory of deuteron stripping, and the five longest range proton groups appear to correspond to ingoing p-neutrons. The properties of the first excited state in  $B^{11}$  are, however, in some doubt. Possible spin assignments for the lower levels of  $B^{11}$  arising from excitation within the p-shell are considered, and the corresponding relative values of the neutron capture probability are listed. (auth)

### 6312

ON THE PHOTODISINTEGRATIONS  $^6Li(\gamma,d)^4He$  AND  $^6Li(\gamma,t)^3He$ . E. W. Titterton and T. A. Brinkley (Australian National Univ., Canberra, Australia). Australian J. Phys. 7, 350-1(1954) June.

Nuclear emulsions loaded with  $Li^6$  were used to determine the lower limit of the  $Li^6(\gamma,d)$  cross section for 17.6 and 14.8-MeV  $\gamma$  rays. The value is  $\sigma_{(17.6 + 14.8)} \leq (2 \pm 2) \times 10^{-30} \text{ cm}^2$ . For the  $Li^6(\gamma,t)$  reaction at 17.6 MeV,  $\sigma \leq (6 \pm 4) \times 10^{-30} \text{ cm}^2$ . (K.S.)

6313

## ANGULAR DISTRIBUTION OF DEUTERONS FROM

$^9\text{Be}(p,d)^8\text{Be}$ . J. Dabrowski and J. Sawicki (Univ. of Warsaw, Poland). *Nuovo cimento* (9) 12, 293-5(1954) Aug. (In English)

The differential cross section for the  $\text{Be}^9(p,d)\text{Be}^8$  reaction was calculated by the use of Born's approximation. The theoretical values of the angular distribution of deuterons in this reaction were compared to experimental values. (J.S.R.)

## PARTICLE ACCELERATORS

6314

[European Council for Nuclear Research]

## POSSIBLE VARIATIONS OF THE GUIDING FIELD IN A SYNCHROTRON DUE TO TRANSIENTS IN THE MAGNET CIRCUIT. July 22, 1954. 16p. (CERN-PS/A. Sch.-1)

The variations of the magnetic guiding field in an alternating-gradient proton synchrotron, caused by transients in the magnet circuit, have been examined. From the results it seems advisable to verify that transients are suppressed by providing a sufficient amount of damping; otherwise appreciable disturbances of the orbit might occur immediately after injection. The damping effect of eddy currents in the iron cores of the magnets is likely to meet this requirement, provided the lamination of the cores is not too fine. (auth)

6315

## TECHNICAL ASPECTS OF PARTICLE ACCELERATORS.

Giovanni Perona and Aldo Persano. *Energia Nucleare*, No. 7, 161-8(1953) May 30. (In Italian).

The technical problems leading to the design and construction of particle accelerators are analyzed. (J.S.R.)

## RADIATION ABSORPTION AND SCATTERING

6316

Radiation Lab., Univ. of Calif., Berkeley

## THE PRODUCTION OF DEUTERONS IN HIGH ENERGY NUCLEON BOMBARDMENT OF NUCLEI, AND ITS BEARING ON NUCLEAR CHARGE DISTRIBUTION (thesis). Wilmot N. Hess. July 27, 1954. 80p. Contract W-7405-eng-48. (UCRL-2670).

A study has been made of deuterons produced at wide angles to a beam of 300-Mev neutrons and a beam of 300-Mev protons. The cross section dependence on atomic number for these deuterons for light elements can be written as  $\sigma = kA^{1.2}$ . This fact and the energy spectra and angular distribution of the deuterons show that the process that forms these deuterons is the indirect pickup process described by Bransden. This is a two step process in which the incident nucleon, or its collision partner, is scattered and then picks up in the same nucleus. A yield of tritons has also been observed that has the same A dependence and is presumably made by the same process. The A dependence of the deuteron production cross section also shows that these deuterons are made on the nuclear surface. Because of this fact, a comparison of the deuteron yields using an incident neutron beam and an incident proton beam can give information about the relative number of neutrons and protons on the surface of the nucleus. An analysis of this sort leads to the conclusion that for heavy nuclei there is a nuclear skin rich in neutrons. For light nuclei the effect is not present. If one assumes that this skin is composed only of neutrons, its thickness must be about  $0.8 \times 10^{-13}$  cm for lead. (auth)

6317

## THE MULTIPLE SCATTERING OF ELECTRONS AND

POSITRONS. C. B. O. Mohr, and L. J. Tassie (Univ. of Melbourne, Australia). *Australian J. Phys.* 7, 217-29(1954) June.

The angular distribution of the single scattering of 33-, 121-, and 1065-kev electrons at small angles in gold is calculated and compared with the distributions given by the Born approximation and by the WKB method as used by Molière. The single scattering distribution for 1065-kev electrons is integrated numerically to give mean square angles of multiple scattering, and these are compared with the values given by the various multiple scattering theories. The results are discussed in conjunction with the experimental data for gold and other elements. The discrepancy between theory and the recent experiments with beryllium is shown to be unexplained by the use of the Hartree instead of the Thomas-Fermi field. The difference of the root mean square angle for electrons and for positrons is estimated for gold and argon, and its value for argon—the only element for which this difference has been measured—is much less than the observed value. (auth)

6318

## THE EQUILIBRIUM ENERGY SPECTRUM OF SHOWER

PHOTONS. P. S. Isaev. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 78-82(1953) Jan. (In Russian).

The equilibrium distribution of shower photons in air is calculated for the energy range 4.3 to 260 Mev, allowance being made not only for radiation damping and pair production but also for ionization losses and the Compton effect. The calculation formulas are derived from the results of Tamm and Belen'ki's paper (*J. Phys. U.S.S.R.* 1, 177 (1939)). The obtained photon spectrum is compared with the calculated. The maximum differences are of the order of 60%. (Science Abstracts)

6319

## DEPENDENCE OF THE IONIZATION CURRENT ON THE

ENERGY OF  $\gamma$  EMISSION. I. V. Estulin. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 221-8(1953) Feb. (In Russian).

The investigation was carried out in air chambers with Pb or C walls. The sensitivity of a slit-type ionization chamber was determined for  $\gamma$ -rays of 0.3 to 3 Mev; the experimentally determined sensitivity is close to the calculated value. The ratio of the ionization currents in a Pb and a C chamber depends on the energy of  $\gamma$ -emission. (Science Abstracts)

6320

## DETERMINATION OF FORCES ACTING BETWEEN ATOMS

WITH THE USE OF THE DIFFERENTIAL CROSS SECTION OF ELASTIC SCATTERING. O. B. Firsov. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 279-83(1953) Mar. (In Russian).

The interaction potential for colliding particles is determined from the given relationship between the angle of scattering  $\alpha$  and the collision parameter  $p$ . A method is indicated whereby  $\alpha(p)$  can be determined from the measured value of the differential cross section of elastic scattering. An example illustrates the use of the formulas derived, and the case of forces of varying sign (attraction at greater, and repulsion at smaller, distances) is discussed in detail. (Science Abstracts)

6321

## RADIATION CHARACTERISTICS OF SEMICIRCULAR,

CIRCULAR, AND RECTANGULAR SURFACE SOURCES. A.

I. Mahan and W. F. Malmberg (U. S. Naval Ordnance Lab., White Oak, Md.). *J. Opt. Soc. Amer.* **44**, 644-53(1954) Aug.

The results of a theoretical study of the radiation characteristics of semicircular, circular, and rectangular surface sources are presented, when these surface sources radiate uniformly over their surfaces and obey Lambert's cosine law. Equations for all three types of sources have been derived, giving the total flux falling on an elementary receiving area when this elementary receiving area has arbitrary coordinates and its surface normal arbitrary direction cosines. The classical method of surface integration has been used in each case. These equations are very general in form so that a large number of the equations already published for these three sources become special cases of these equations for which either the coordinates or the direction cosines of the surface normal of the elementary receiving area have particular values. These equations are equally applicable to problems for which the previously designated elementary receiving area becomes the source and the semicircular, circular, and rectangular areas the receiving areas. A simple translation and rotation of coordinates also makes it possible to consider the equally important problems for which the sources are permitted to have arbitrary coordinates and surface normals with arbitrary direction cosines. With these equations in this form, it becomes possible to calculate the total flux falling on the elementary receiving area. One numerical example is included for each of three sources showing how these equations may be used to determine the total flux falling on the elementary receiving area when it is limited to particular planes. (auth)

### 6322

PION-NUCLEON SCATTERING BY VARIATIONAL METHOD. L. Sartori (Univ. of Turin, Italy) and V. Wataghin (Istituto Nazionale di Fisica Nucleare, Milan, Italy). *Nuovo cimento* (9) **12**, 260-9(1954) Aug.

$\pi$ -wave phase shifts in pion-nucleon scattering are calculated in a nonrelativistic approximation of the PS (PS) theory with a cut-off at the nucleon mass. The variational procedure proposed by Cini and Fubini is applied; charge renormalization is performed in a manner similar to that used by Deser, Thirring, and Goldberger. For pion energy sufficiently high, the phase shifts found have the correct sign and qualitative energy dependence; however, the magnitudes are much too large. (auth)

### 6323

THE SCATTERING OF 15.7 MEV NEUTRONS BY  $^4\text{He}$ . M. H. Alston, A. V. Crewe, W. H. Evans, L. L. Green, and J. C. Willmott (Univ. of Liverpool, England). *Proc. Phys. Soc. (London)* **A67**, 657-62(1954) Aug.

The angular distribution of the  $\alpha$  particles from collisions with 15.7-Mev neutrons has been studied using a diffusion cloud chamber. The results indicate that a  $D_{3/2}$  phase shift slightly smaller than the hard sphere value must be used to obtain the best fit. (auth)

### 6324

INELASTIC COLLISIONS BETWEEN HEAVY PARTICLES. II. CONTRIBUTIONS OF DOUBLE-TRANSITIONS TO THE CROSS SECTIONS ASSOCIATED WITH THE EXCITATION OF HYDROGEN ATOMS IN FAST ENCOUNTERS WITH OTHER HYDROGEN ATOMS. D. R. Bates and G. W. Griffing (Queen's Univ., Belfast, Ireland). *Proc. Phys. Soc. (London)* **A67**, 663-8(1954) Aug. (cf. NSA 8-926).

Born's approximation is used to calculate the cross sections of the processes  $\text{H}(1s) + \text{H}(1s) \rightarrow \text{H}(2s \text{ or } 2p) +$

$\text{H}(2s, 2p, 3s, 3p, 3d, \text{ or } C)$ , where C represents the continuum. The results are presented mainly in graphical form. It is found that these double-transition collisions are together much more effective at high impact energies than are simple single-transition collisions such as  $\text{H}(1s) + \text{H}(1s) \rightarrow \text{H}(2s \text{ or } 2p) + \text{H}(1s)$ . An asymptotic formula for the total inelastic cross section is also obtained. (auth)

### 6325

ON THE THICK TARGET BREMSSTRAHLUNG SPECTRUM AT RELATIVISTIC ENERGIES. K. Phillips (Metropolitan-Vickers Electrical Co. Ltd., Manchester, England). *Proc. Phys. Soc. (London)* **A67**, 669-72(1954) Aug.

The bremsstrahlung energy distribution has been measured for 9-Mev electrons striking a thick copper target. This method involves the energy measurement of the photo-protons produced in the  $\text{H}^2(\gamma, n) \text{H}^1$  reaction. The experimental results are compared with a theoretical distribution which is deduced from the thin-target bremsstrahlung spectrum. By invoking the usual expressions for the energy loss by ionization and radiation of the incident electrons in the target, reasonable agreement between experiment and theory is found. (auth)

### 6326

THE SECOND BORN APPROXIMATION IN INELASTIC COLLISIONS OF ELECTRONS WITH ATOMS. W. Rothenstein (Univ. Coll. and Battersea Polytechnic, London, England). *Proc. Phys. Soc. (London)* **A67**, 673-83(1954) Aug.

The second approximation in Born's theory of collisions is worked out for the excitation of the 2p state of hydrogen and of the  $2^1\text{P}$  state of helium from the corresponding ground states by electron impact. The method is not applicable to electron energies too close to the threshold. The correction introduced by the second approximation, which reduces the intensity of the small angle inelastic scattering and the total inelastic cross section by an amount increasing as the electron energy decreases, is of the correct sign and about the right magnitude, in the energy range to which it is applicable, to provide an explanation of the discrepancies between calculated and observed cross sections for excitation of optically allowed transitions. (auth)

### 6327

ANNIHILATION OF POSITRONS IN LIQUID HELIUM. Frank L. Hereford (Univ. of Virginia, Charlottesville). *Phys. Rev.* **95**, 1097-8(1954) Aug. 15.

The differential pulse-height spectra of three-photon annihilation of positrons in liquid He and Al were measured. The two spectra were identical, indicating no appreciable increase of triplet annihilations in liquid He as compared with Al. (K.S.)

### 6328

POLARIZATION IN n-p SCATTERING AT 100-200 MEV. A. Roberts, J. Tinlot, and E. M. Hafner (Univ. of Rochester, N. Y.). *Phys. Rev.* **95**, 1099-1100(1954) Aug. 15.

Results obtained from the study of azimuthal asymmetries in the charge-exchange scattering of partially polarized neutrons by H and C are reported. Asymmetries observed were for a primary proton energy of 230 Mev, first scattering angles of 15 and 30°, first targets of Be and C, a neutron threshold of 100 Mev, second scatterers of C and H, and second angles up to 55°. It was found that  $P(p-C-n, 30^\circ) = P(n-C-p, 30^\circ) = +0.19 \pm 0.02$ ,  $P(p-Be-n, 30^\circ) = +0.13 \pm 0.03$ ,  $P(n-H-p, 30^\circ) = +0.15 \pm 0.05$ , and  $P(n-H-p, 55^\circ) = -0.55 \pm 0.15$ . (K.S.)

## 6329

MESON-PROTON SCATTERING PHASE SHIFT ANALYSIS. H. A. Bethe (Cornell Univ., Ithaca, N. Y.) and F. de Hoffmann (Los Alamos Scientific Lab., N. M.). *Phys. Rev.* **95**, 1100-1(1954) Aug. 15.

Experimental information available to date on direct  $\pi^+$  and  $\pi^-$  scattering and  $\pi^-$  charge exchange scattering from H between 0 and 217 Mev is surveyed and analyzed. (K.S.)

## 6330

POLARIZATION OF HIGH-ENERGY DEUTERONS. Owen Chamberlain, Emilio Segrè, Robert Tripp, Clyde Wiegand, and Thomas Ypsilantis (Univ. of California, Berkeley). *Phys. Rev.* **95**, 1104-5(1954) Aug. 15.

The intensity distribution produced by 167-Mev polarized deuterons and carbon scatterers was found to be  $I(20^\circ, \phi) = p + q \cos \phi + r \cos 2\phi$ , with  $p = 50.3 \pm 2.2$ ,  $q = 15.3 \pm 1.9$ , and  $r = -1.8 \pm 3.6$  in units of  $10^{-27} \text{ cm}^2/\text{steradian}$ . This result is in good agreement with the intensity distribution derived theoretically. (K.S.)

## 6331

MECHANISM OF PROTON POLARIZATION IN HIGH-ENERGY COLLISIONS. Owen Chamberlain, Emilio Segrè, Robert Tripp, Clyde Wiegand, and Thomas Ypsilantis (Univ. of California, Berkeley). *Phys. Rev.* **95**, 1105-6(1954) Aug. 15.

The polarization mechanism of a high-energy proton beam was studied with reference to purely elastic scattering processes applicable to diffraction scattering. Selection of these protons was accomplished by using a detecting telescope with enough absorber to exclude protons which suffered appreciable energy loss. The differential cross section for left and right scattering of a 300-Mev proton beam was measured in various scatterers at an angle of  $9^\circ$ . The symmetry was calculated from observed scattering data, and a high degree of proton polarization was indicated. (K.S.)

## 6332

NUCLEAR ELASTIC SCATTERING OF PHOTONS. Evans Hayward and E. G. Fuller (National Bureau of Standards, Washington, D. C.). *Phys. Rev.* **95**, 1106-7(1954) Aug. 15.

The differential elastic scattering cross section of photons in the energy range of 4 to 28 Mev was measured at  $120^\circ$  for Cu, Mn, Sn, Au, Bi, and Pb. For all these elements except Au, a pronounced peak was found near the  $(\gamma, n)$  threshold, in addition to the giant resonance. The qualitative features of the cross sections obtained are in agreement with the predictions of Bethe and Ashkin. For Au, the neutron yield curve does not join smoothly with the elastic scattering curve, indicating that inelastic scattering is larger than elastic scattering for energies just below the  $(\gamma, n)$  threshold. (K.S.)

## 6333

THEORY OF MULTIPLE COULOMB SCATTERING FROM EXTENDED NUCLEI. Leon N. Cooper and James Rainwater (Columbia Univ., New York). *Phys. Rev.* **95**, 1107-9(1954) Aug. 15.

Recent cosmic-ray experiments, indicating an anomalous  $\mu$ -nuclear interaction in the multiple scattering distribution of relativistic  $\mu$  mesons, have demonstrated the absence of a reliable theory on which to predict multiple scattering distributions at large angles. The Olbert and Molière theories are discussed in connection with the problem, and two new methods for an extended nucleus are developed which give results in good agreement with each other. (K.S.)

## 6334

POLARIZATION OF NUCLEONS ELASTICALLY SCATTERED FROM NUCLEI. Warren Heckrotte and Joseph V. Lepore (Univ. of California, Berkeley). *Phys. Rev.* **95**, 1109-10(1954) Aug. 15.

## 6335

THE REACTION  $p + p \rightarrow \pi^+ + d$  WITH POLARIZED PROTONS. F. S. Crawford, Jr., and M. L. Stevenson (Univ. of California, Berkeley). *Phys. Rev.* **95**, 1112(1954) Aug. 15.

Measurements of left-right asymmetry of meson production in the plane perpendicular to a beam of polarized protons ( $P \approx 0.73$ ) were made, using coincidence detection of the meson and deuteron and a liquid- $H_2$  target. Proton energies were 310 and 317 Mev. The results of the raw data are  $(R-L)/(R+L) = 0.16 \pm 0.03$  and  $0.23 \pm 0.04$  at 317 and 310 Mev, respectively. R and L refer to the direction of the produced meson as seen by the incident proton. (K.S.)

## RADIATION EFFECTS

## 6336

EFFECTS OF NUCLEAR RADIATION ON THE ELECTRICAL RESISTIVITY AND HARDNESS OF METALS. Luigi Mongini. *Energia Nucleare*, No. 8, 209-20(1953) Aug. 20. (In Italian).

The results obtained in the study of the variations in electrical resistivity and hardness of some metals and alloys as a result of nuclear radiation are presented. 15 references. (J.S.R.)

## 6337

RADIATION EFFECTS ON STRUCTURAL MATERIALS. C. R. Sutton and D. O. Leiser (Argonne National Lab., Lemont, Ill.). *NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12*, 208-21(1954).

The fact that reactors have been in successful operation for some years proves indirectly that reactor radiation effects on the mechanical and physical properties of metals are not catastrophic; however, they must be determined quantitatively for design use. Test data indicate that properties such as hardness, tensile strength, impact strength, magnetic susceptibility, and electrical resistivity are structure sensitive. The degree of property change appears related to the original condition and/or structure of the particular materials as well as to the flux dosage and exposure temperature. (auth)

## 6338

HOW NUCLEAR RADIATION AFFECTS ENGINEERING MATERIALS. D. O. Leiser (Argonne National Lab., Lemont, Ill.). *Materials and Methods* **40**, 110-20(1954) Aug.

The effects of various radiation intensities on the mechanical and physical properties of metals (stainless steels, carbon steels, Ni, Ni alloys, Zr, Tantalum, W, Tantalum G, Ta, and Co alloys) and nonmetals (elastomers, electric insulators, plastics, and oils) are given. Results are tabulated. The mechanisms of radiation damage and test procedures are discussed. (J.A.G.)

## 6339

QUANTITATIVE MEASUREMENTS OF THE ELEMENTARY PROCESS OF THE PHOTOEXCITATION OF LUMINOUS SUBSTANCES BY SINGLE  $\alpha$  PARTICLES. II. Immanuel Broser and Claus Reuber. *Z. Naturforsch.* **9a**, 689-93(1954) July-Aug. (In German).

The flash of light, excited by  $\alpha$  particles, in crystal phosphors was investigated by an indirect method measurement. The apparatus used permits the determination of the time constant and the rule for the decay process. In  $ZnS-Cu$ ,

- \* ZnS-Ag, and ZnS/ZnSe-Ag the quadratic-hyperbolic decay forms were found. The probability for the transition combined with light emission was determined. (tr-auth)

## RADIOACTIVITY

6340

Mound Lab.

THE HALF-LIFE OF YTTRIUM-90. (INFORMATION REPORT). H. W. Kirby and Murrell L. Salutsky. Feb. 1, 1954. 8p. Contract AT-33-1-GEN-53. (MLM-937)

Carrier-free  $Y^{90}$  was separated from  $Sr^{90}$  by two strontium nitrate precipitations from 80% nitric acid using inert strontium carrier. The half life, determined by beta counting, was found to be  $64.029 \pm 0.024$  hr. (auth)

6341

Scott Lab. of Physics, Wesleyan Univ., Middletown, Conn. INVESTIGATIONS IN NUCLEAR SPECTROSCOPY. FINAL REPORT [FOR] JUNE 1, 1953 TO AUGUST 31, 1954. Forrest L. Booley. 11p. Contract DA-19-059-ORD-1433. (NP-5312)

The energy spectra of  $\beta$  and  $\gamma$  radiations from  $Al^{29}$ ,  $Ge^{77}$ ,  $In^{116}$ ,  $Hg^{205}$ ,  $P^{34}$ ,  $Ag^{110}$ ,  $V^{52}$ , and  $Zn^{71}$  were studied. Research was begun on angular correlations in  $Pd^{106}$  and  $Sb^{124}$ . (K.S.)

6342

THE DECAY OF THE 7.68 MEV STATE IN  $^{12}C$ . R. G. Uebergang (Univ. of Melbourne, Australia). Australian J. Phys. 7, 279-83(1954) June.

A polonium-beryllium source has been used to investigate the radiations in coincidence with the 4.43-Mev  $\gamma$  ray leading to the ground state of  $C^{12}$ . The coincident radiation consisted of a continuum due to neutrons and a  $\gamma$  ray of energy 3.05 Mev and intensity 0.12 to 0.08 that of the 4.43-Mev  $\gamma$  ray. This indicates that the 7.68 Mev state of  $C^{12}$  decays principally by cascade  $\gamma$  emission. (auth)

6343

DISINTEGRATION RATE OF CARBON-14. R. S. Caswell, J. M. Brabant, and A. Schwebel (National Bureau of Standards Washington, D. C.). J. Research Natl. Bur. Standards 53, 27-8(1954) July.

The energy emission rates of  $C^{14}$  samples have been measured with an extrapolation ionization chamber. From the energy emission rates, the disintegration rates are determined through knowledge of the average beta-ray energy emitted per disintegration. From earlier data on the isotopic abundance, a value for the half life of  $C^{14}$  of  $5,900 \pm 250$  years is obtained. (auth)

6344

NATURAL RADIOACTIVITY OF PLATINUM AND NEODYMIUM. W. Porschen and W. Riezler (Univ. of Bonn, Germany). Z. Naturforsch. 9a, 701-3(1954) July-Aug. (In German).

Nuclear plates were impregnated with Pt and Nd by the use of aqueous solutions of their compounds. After a number of days the plates were developed, and the  $\alpha$  particles were counted. The decay constant for Pt was  $\lambda = 8.5 \times 10^{-17}$  yr, and the half life was  $T = \alpha 8 \times 10^{16}$  yr ( $\alpha$  is the abundance of the active isotope).  $Pt^{190}$  ( $\alpha = 0.006\%$ ) was the active isotope with a half life of  $5 \times 10^{11}$  yr. The decay constant for Nd was  $\lambda = 3.5 \times 10^{-17}$  yr, and the half life was  $T = \alpha 2 \times 10^{16}$  yr.  $Nd^{144}$ , the active isotope with  $\alpha = 23.9\%$ , has a half life of  $5 \times 10^{15}$  yr. The decay energy of Pt was calculated as 3.1 Mev and of Nd, as 1.9 Mev, both in agreement with experimental values. (tr-auth)

6345

$\beta$ -DISINTEGRATION OF THE NUCLEI OF THE TYPE  $2M^{2Z-1}$ . D. Ivanenko and S. Larin. Zhur. Eksptl'. i Teoret. Fiz. 24, 359-61(1953) Mar. (In Russian).

The R-Z curves obtained by 4 methods are compared: (1) from  $R = 1.5 \times 10^{-13} \times M^{1/2}$  cm; (2) from total cross sections; (3) from radii of "mirror" nuclei obtained from the energy of the  $\beta$  disintegration; and (4) from  $\alpha$  disintegration. Kinks in the curves (particularly in (3) and (4)) coincide with some of the known critical numbers of nucleons ( $Z = 8, 14, 20, 28, 50, 82, 90$ ). The divergences between the curves are discussed. (Science Abstracts)

## SPECTROSCOPY

6346

Industrial Scientific Co.

INFRARED EMISSION AND ABSORPTION OF CARBON DIOXIDE AT HIGH TEMPERATURES. Richard H. Tourin and Morris Grossman. May 1954. 121p. Contract AF-18(600)-596, Technical Report No. 258. (NP-5299)

The infrared emission and absorption of heated carbon dioxide, enclosed in a special gas cell, have been measured at temperatures from 25 to 1000°C and at pressures up to 1000 mm Hg. Spectral absorptivities and absorption coefficients were calculated from spectrum tracings of the 4.3- $\mu$  fundamental band and the 2.7- $\mu$  combination bands at concentrations up to 17 cm-atm. Saturation with respect to partial pressure, temperature, and total pressure was observed over most of the spectrum. A quantitative picture was obtained of the relation between temperature and the molecular spectral energy distribution. (auth)

6347

ORDWES Lab., Wesleyan Univ.

TWO PENDULUM TYPE SPECTROGRAPHS. R. S. Kardas, C. B. Ford, K. Routsis, and A. G. Chartier. Sept. 30, 1953. 21p. Contract AF-33(038)-3664. (ORDWES-TN-35; AD-18450)

The transmission grating pendulum-type spectroscope gave a dispersion of 75 A/mm which allowed identification and comparison of line and band intensities of simple spectra. None of five Cenco transmission replica gratings, of 15,000 and 25,000 lines/in. type, produced a nonstriated spectrum. The 16 A/mm dispersion produced by the 15,300 lines/in. grating of the reflection grating pendulum-type spectrograph aided in line and band density measurement. No rotational bands were resolved. (J.E.D.)

6348

LARGE PRISMATIC  $\beta$  SPECTROMETER WITH TWO MAGNETIC LENSES. V. M. Kel'man, D. L. Kaminski, and V. A. Romanov. Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 18, 209-14 (1954) Mar.-Apr. (In Russian).

The design and performance of a large prismatic  $\beta$  spectrometer with two magnetic lenses is described in detail. The instrument has high resolution and great clearness. (J.S.R.)

6349

CALCULATION OF THE ELECTRON-OPTICAL PARAMETERS OF  $\beta$  SPECTROMETERS WITH TWO FOCUSED ELECTRON BEAMS. A. V. Zolotavin and V. S. Sadkovskii. Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 18, 215-26(1954) Mar.-Apr. (In Russian)

6350

ON THE QUESTION OF THE CALCULATION OF THE ANA-

LYTICAL FORMS OF THE TRAJECTORY OF CHARGED PARTICLES IN A MAGNETIC FIELD OF AXIAL SYMMETRY, USED IN MODERN  $\beta$  SPECTROMETERS. V. R. Saulit. *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* 18, 227-32(1954) Mar.-Apr. (In Russian).

6351

ISOTOPE SHIFT IN X-RAY SPECTRA OF HEAVY ELEMENTS. G. Igo and M. S. Wertheim (Yale Univ., New Haven, Conn.). *Phys. Rev.* 95, 1097(1954) Aug. 15.

The volume effect theory is used to calculate expected isotope shifts in the x-ray spectra of heavy elements. Expected displacements of 0.051 ev for  $U2p_{1/2}$  and 0.088 ev for  $Mo 2s_{1/2}$  are calculated. The  $2s_{1/2}$  level in U is seen to have a large expected shift. (K.S.)

6352

BACHER AND GOUDSMIT THEORY OF COMPLEX SPECTRA. R. E. Trees (National Bureau of Standards, Washington, D. C.). *J. Research Natl. Bur. Standards* 53, 35-48 (1954) July.

The Bacher and Goudsmit theory expresses the energy of a state of an atom in terms of a linear combination of energies of states of other ions of the same atom. This theory is tested in the spectra with d- and s-electrons and general conclusions drawn about its accuracy. In deriving their theory, Bacher and Goudsmit formally introduced many-particle interactions. They showed (to a limited extent) that this was equivalent to a second procedure in which the zero-order wave functions were assumed to be independent of the ionization and successive orders of perturbations were included. Recently it has been shown that a linear theory, which is a combination of the Slater theory and an empirically derived correction, predicts the separation of terms in any one configuration with about the same accuracy as the Bacher and Goudsmit theory; in this theory, the wave functions are allowed to depend on the degree of ionization. It is shown that the Bacher and Goudsmit theory can be interpreted in a third way that is consistent with this linear theory. In the light of this latter interpretation, Racah has suggested an empirical modification of the Bacher and Goudsmit theory that often leads to better results; this suggestion has been incorporated in the present paper. (auth)

6353

THE TRIPLET SPLITTING OF TERMS OF THE CARBON ATOM IN CONFIGURATION  $1s^2 2s^2 2p^3$ . V. K. Shugurov, Ya. I. Vizbaraitė, and A. P. Yutsis. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 265-8(1953) Mar. (In Russian).

Expressions are given for the elements of the energy matrix of spin interaction, using the radial integral for an atom in the  $1s^2 2s^2 2p^3$  configuration. The triplet splitting of C atoms in this configuration is determined, allowance being made for the non-diagonal matrix elements, with the use of one-electron wave functions of a self-consistent field without quantum exchange. (Science Abstracts)

## THEORETICAL PHYSICS

6354

ON NUCLEAR SPIN DETERMINATION THROUGH INELASTIC SCATTERING. (Zur Kernspinbestimmung Durch Inelastische Streuung). O. Hittmair. Translated from *Acta Phys. Austriaca* 6, 241-5(1953). 5p. (UCRL-Trans-175).

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-3286.

6355

UTILIZATION OF THE PERMITTED  $\beta$  CONVERSIONS FOR THE DETERMINATION OF INTERACTIONS GENERATING  $\beta$  DECAY. Ya. B. Zel'dovich. *Izvest. Akad. Nauk S.S.S.R. Ser. Fiz.* 18, 243-6(1954) Mar.-Apr. (In Russian).

For the clarification of the nature of Fermi interaction in  $\beta$  decay (choice between scalar S and vector V in interaction) a measurement of the correlation between electrons and neutrons from decay of  $N^{13}$  and  $O^{15}$ , where 75% of the decay depends on Fermi interaction and only 25% on tensor interaction, was suggested. For clarification of the sign in the expression  $S \pm T$  or  $V \pm T$ , it was suggested to measure the polarization (direction of the spin) of  $\beta$  particles. In the variant  $S + T$  the spin of slow electrons and positrons is connected to the neutron spin and not that of the proton. In  $S - T$  the spin is connected only to proton spin. These variants do not satisfy the principle of charge symmetry. (tr-auth)

6356

THE COUPLING CONSTANT IN FIELD THEORY. G. Källén (Univ. of Lund, Sweden). *Nuovo cimento* (9) 12, 217-25(1954) Aug. (In English)

The various possible definitions of the coupling constant in quantum electrodynamics and in meson theory are reviewed, and their properties are discussed. It is pointed out that the gauge invariance of quantum electrodynamics makes the definition of the renormalized charge unique, at least in a certain sense. This simplification does not occur in meson theory where the definition of the coupling constant is more ambiguous. A recent attempt at comparing different mesic charges is discussed. (auth)

6357

ON THE POLARIZATION OF HIGH ENERGY NUCLEONS SCATTERED BY A NUCLEAR FIELD. B. Bosco and T. Regge (Univ. of Turin, Italy). *Nuovo cimento* (9) 12, 285-7 (1954) Aug. (In English)

The exact values of the asymmetry coefficient in the polarization of light energy nucleons scattered by a nuclear field were calculated as a function of the scattering angles. (J.S.R.)

6358

ON THE MECHANISM OF FISSION AT VERY HIGH ENERGY. L. Marquez (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil). *Nuovo cimento* (9) 12, 288-9(1954) Aug. (In English)

A fission mechanism is proposed in which the nucleonic cascade produced in the heavy nucleus by the incoming particle leaves enough excitation to cause immediate fission, and then the excited fission fragments emit six neutrons each, in a process described by the evaporation theory. An experimental method to determine the time of emission of the neutrons is described. (J.S.R.)

6359

THE POTENTIAL BETWEEN NUCLEONS. Gernot Eder (Max-Planck-Institut für Physik, Göttingen, Germany). *Z. Naturforsch.* 9a, 565-72(1954) July-Aug. (In German).

On the basis of the hypothesis of the charged-symmetrical, pseudoscalar meson theory, the nonadiabatic correction for the second and fourth perturbation theory approximation was calculated by a consideration of the nucleon recoil. A strongly attractive potential of the fourth order was obtained. The spin-orbit coupling and the saturation of the nuclear force was discussed. (auth)

6360

NON-LOCAL FIELD THEORY ON THE BASIS OF THE SAL-

PETER-BETHE EQUATION. II. INTERACTION WITH LOCALIZED PARTICLES. H. L. Jordan and W. E. Frahn. *Z. Naturforsch.* **9a**, 572-8(1954) July-Aug. (In German). (cf. NSA 8-2075)

The Salpeter-Bethe equation for the case of the interaction with a localized heavy particle was derived. It is shown that the interaction has, in the second perturbation theory approximation, a nonlocal structure. As an example of the simple irreducible graph of the fourth order, the interaction function was calculated, and its space-time structure and the transition to the local potential in the adiabatic approximation were discussed. (tr-auth)

6361

CORPUSCULAR STATISTICAL BASIS OF QUANTUM MECHANICS. Fritz Bopp (Univ. of Munich). *Z. Naturforsch.* **9a**, 579-600(1954) July-Aug. (In German).

An attempt was made to formulate quantum mechanics as pure statistical mechanics which do not reduce to Newtonian mechanics. The wave character of the statistical laws of motion is restricted from the peculiarity of the statistical quantum mechanics, according to which the reversibility of motion is found with diffusion phenomena. The existence of particles is proved as is the hypothesis for waves. (tr-auth)

6362

A TENTATIVE THEORY OF  $\Lambda$ -PARTICLES. THEORY OF 4-DIMENSIONAL  $\tau$ -SPACE. Tadao Nakano and Ryôyû Utiyama (Osaka City Univ. and Osaka Univ., Japan). *Progr. Theoret. Phys. (Japan)* **11**, 411-24(1954) Apr.-May.

In order to describe new kinds of particles, a four dimensional Euclidian  $\tau$ -space  $S_4$  is introduced. Every elementary particle is supposed to be described by a particular irreducible spinor in  $S_3$  which is imbedded in  $S_4$  as a subspace. Any one of the wave functions is assumed to correspond, respectively, to a particular one of irreducible spinors in  $S_4$ , which will be decomposed into a sum of several parts, each one of which corresponds to a particular kind of elementary particle. The nucleon and the  $\Lambda$ -particle are described by a single spinor corresponding to the representation  $R_{\frac{1}{2}, \frac{1}{2}}$  ( $= D_{\frac{1}{2}, 0} + D_{0, \frac{1}{2}}$ ), and the  $\pi$  meson together with the  $\theta$  meson by an antisymmetric tensor in  $S_4$ . (auth)

6363

A VARIATION PRINCIPLE IN DEUTERON PROBLEM. Takashi Kikuta (Univ. of Tokyo, Japan). *Progr. Theoret. Phys. (Japan)* **11**, 493-4(1954) Apr.-May.

A variational principle is developed for determining the depths of central and tensor potentials, when the binding energy and mixing ratio for the D wave to the S wave in the deuteron state are given. (K.S.)

6364

COVARIANT SUBTRACTION OF "OVERLAPPING DIVERGENCES" APPEARING IN THE PION-NUCLEON SCATTERING. Daisuke Ito and Hiroshi Tanaka (Tokyo Univ. of Education, Japan). *Progr. Theoret. Phys. (Japan)* **11**, 501-3(1954) Apr.-May.

A method is discussed for subtracting the so-called overlapping divergences which appear in the solution of Bethe-Salpeter equations for pion-nucleon scattering. The finite part of the scattering matrix elements is constructed in closed form. (K.S.)

6365

A METHOD FOR THE SOLUTION OF NUCLEAR BOUND-STATE PROBLEMS. I. E. McCarthy and H. S. Green (Univ. of Adelaide, Australia). *Proc. Phys. Soc. (London)* **A67**, 719-25(1954) Aug.

It is shown that the Fredholm method for the solution of integral equations can be adapted to solve the covariant scattering equations for the proton-neutron system and the meson-nucleon system. A practical method is devised for obtaining the binding energies of the deuteron and hyperon in a fully covariant way. As a test of the method it has been applied to the corresponding noncovariant equation for the deuteron, and satisfactory numerical results are obtained. (auth)

6366

ON THE VALIDITY OF SEMI-EMPIRICAL ATOMIC MASS-FORMULA IN THE REGION OF RARE-EARTH NUCLIDES. G. P. Dube and Lal Saheb Singh (Patna Univ., India). *Indian J. Phys.* **28**, 177-82(1954) Apr.

It is shown that the Fermi's semi-empirical atomic mass formula is quite inadequate for the calculation of alpha-decay energy in the region of rare earths. The calculated alpha-decay energy is much lower and even negative in several cases while the observed one ranges from 2 to nearly 4 Mev. A suitable correction term has been added to Fermi's mass formula in the rare-earth region on the basis of Duckworth's new atomic mass data. With the introduction of the correction term the calculated alpha-disintegration energy is in agreement with the observed results. (auth)

6367

ANALYTICAL WAVE FUNCTIONS AND ENERGY VALUES OF THE LITHIUM-TYPE ATOMS. M. G. Veselov. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, 65-8(1953) Jan. (In Russian).

Wave functions have been derived and energy values calculated for atoms with 3 electrons and any value of Z (nuclear charge) by the method of variation of parameters in the analytical expressions for the H-type atom. Semi-empirical formulas have been constructed for: (1) the total energy  $W = -1.125Z^2 + 1.0028Z - 0.3962 - 0.0727/Z - 1.078 \times 10^{-6}Z^4$ ; (2) the ionization potential  $I = 0.125Z^2 - 0.3978Z + 0.2437 + 0.0674/Z + 1.46 \times 10^{-6}Z^4$  of the Li-type atoms. Owing to the introduction of the semi-empirical  $Z^4$  terms allowing for the relativistic effects, these formulas agree with experimental data within the limits of accuracy of spectroscopical measurements. (Science Abstracts)

6368

THE ENERGY SURFACE AND THE STABILITY OF HEAVY NUCLEI. V. A. Kravtsov. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, 242-4(1953) Feb. (In Russian).

The surface  $E = f(Z, A)$  representing the dependence of the binding energy of nucleons on the atomic number and mass number is constructed. The surface has a "hollow" at  $Pb^{208}$ , which lies at the intersection of two "grooves" along the lines  $Z = 82$  and  $N = 126$ . (Science Abstracts)

6369

NUCLEAR SHELLS. V. A. Kravtsov. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, 244-6(1953) Feb. (In Russian).

The "energy surface" sections are analyzed by different (even and odd) A planes. The six regions of high-stability nuclei found experimentally around  $Si^{28}$ ,  $Ni^{62}$ ,  $Sr^{88}$ ,  $Sn^{120}$ ,  $Ce^{140}$ , and  $Pb^{208}$  have the form of two "grooves" intersecting at the above six "hollows." (Science Abstracts)

6370

MIXED DOUBLE DISINTEGRATION-CAPTURE PROCESSES. N. N. Kolesnikov. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, 246-7(1953) Feb. (In Russian).

A theory is developed not involving neutrinos for the double mixed disintegration-absorption processes  $\beta^+ K$  and  $\beta^- K$ . (Science Abstracts)

6371

FORMATION OF METASTABLE COMPOUNDS FROM ELEMENTARY PARTICLES (POSITRONIUM). A. A. Sokolov and V. N. Tsytoich. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 253-64(1953) Mar. (In Russian).

The interaction between quantized states is discussed, and the wave functions with fourth-order matrices are converted into those with second-order matrices. Approximate formulas are obtained for the interaction between two charged particles. The wave functions and energy of positronium are derived, thus enabling the possibility of formation of metastable positronium states to be assessed. The positronium transitions in magnetic field are discussed. (Science Abstracts)

6372

STATISTICAL THEORY OF THE ATOMIC NUCLEUS. B. Kerimov. *Zhur. Eksptl'. i Teoret. Fiz.* 24, 299-302(1954) Mar. (In Russian).

The idea of D. Ivanenko and A. Sokolov (*Classical Field Theory*, GITTL, Moscow-Leningrad, 1951, pp.402-4) is developed, according to which, in the statistical theory of heavy nuclei, the assumption of mesons having a lesser mass than that usually accepted can yield values of bonding energy and nuclear radius which are in relatively better agreement with experimental data. The stability of heavy nuclei is investigated from the point of view of the field theory of nuclear forces. The bonding energy is expressed as a function of the mass number and of the nuclear bonding parameters. The range of variation is found for the meson mass and the bonding parameters, within which the nuclear equilibrium is possible. (Science Abstracts)

#### URANIUM AND URANIUM COMPOUNDS

6373

PREFERRED ORIENTATION IN  $\alpha$ -URANIUM. C. M. Mitchell and J. F. Rowland (Dept. of Mines and Technical

Surveys, Ottawa, Ontario, Canada). *Acta Met.* 2, 559-72 (1954) July.

The preferred orientation of uranium rolled in the  $\alpha$  range has been investigated by x-ray diffraction using a spherical specimen in the Geiger counter spectrometer. Complete figures of the principal pole distributions have been obtained without absorption correction. At low rolling temperatures, a texture is obtained having principal pole maxima corresponding to a single unit cell orientation. The (001) and (100) pole maxima lie in the plane normal to the rolling direction at 30 and 60 degrees, respectively, to the compression axis; the (010) pole maximum is parallel to the rolling direction. At higher rolling temperatures near the recrystallization point a duplex texture is obtained, having a common (001) pole maximum at 20 degrees to the compression axis and having the (010) and (110) poles parallel to the rolling direction. The unit cell probability distribution has been derived using two principal pole distributions, and from this the inverse pole figures have been calculated, giving the distributions of the compression axis and of the rolling direction over the unit cell. A direct comparison of the rolling figures predicted by Calnan and Clews is obtained from the inverse pole figures. Good agreement is obtained with the figures predicted for rolling at low temperatures where deformation occurs predominantly by twinning with a small amount of slip. The rolling figures obtained at high temperatures giving the duplex texture are not in agreement with Calnan and Clews. A treatment of the deformation of  $\alpha$  uranium during tension, compression, and rolling is described using the glide mechanisms determined by Cahn, which is compatible with both the low- and high-temperature textures. The reorientation of the (010) axial and the duplex (010)-(110) axial textures upon recrystallization has been investigated. The (010) texture is shown to be relatively stable under recrystallization. The duplex texture undergoes reorientation to give a single component texture having the (151) pole axial. A (100) pole maximum occurs along the rolling direction which is shown to be due to overlapping of four symmetric components. (auth)

